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TECHNICAL BULLETIN No. 20—Revised

Oregon State Highway Department

W. C. WILLIAMS, State Highway Engineer

STANDARD HIGHWAY SPIRAL

OREGON STATE
HIGHWAY DEPARTMENT
TRAFFIC ENGINEERING DIV.
SALEM, OREGON
TECHNICAL LIBRARY COPY

By

H. W. LIBBY

and

E. M. BOOTH

Published by

OREGON STATE HIGHWAY COMMISSION
SALEM

M. K. McIVER, Chairman
KENNETH N. FRIDLEY, Commissioner
GLENN L. JACKSON, Commissioner

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Revised Under Supervision of

TOM EDWARDS, *Construction Engineer*

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November 1, 1959

STATE PRINTING

THE STANDARD HIGHWAY SPIRAL

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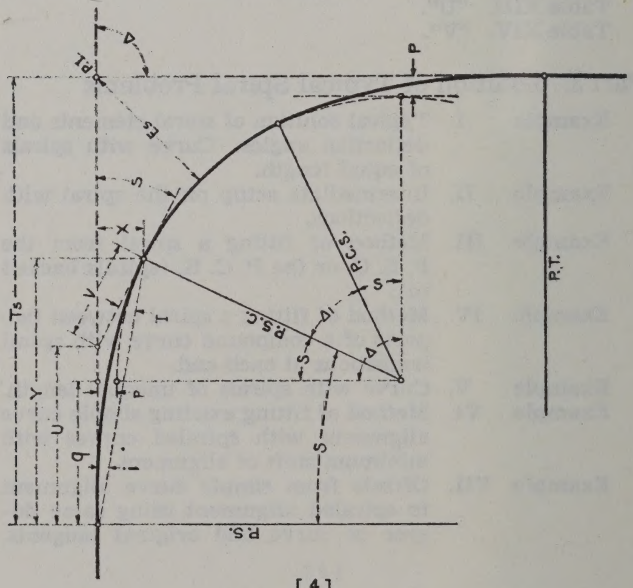
THE STANDARD HIGHWAY SPIRAL NOTATION

P. T. = Point of change in alignment from spiral to tangent.
P. S. = Point of change from tangent to spiral.
P. S. C. = Point of change from spiral to circular curve.
P. C. S. = Point of change from circular curve to spiral.
P. R. S. = Point of reverse spirals.
P. S. S. = Point of change from increasing to decreasing spiral.
P. O. S. = Point on spiral.
P. O. C. = Point on circular curve.
P. O. S. T. = Point on semi-tangent.
P. O. T. = Point on tangent.



THE STANDARD HIGHWAY SPIRAL

U = The distance on the tangent from the P. S. to the intersection with a tangent through the P. S. C.; the longer spiral tangent.

V = The distance on the tangent through the P. S. C. from the P. S. C. to the intersection with the tangent through the P. S.; the shorter spiral tangent.

Y = The abscissa or tangent distance of the P. S. C., referred to the P. S.

X = The ordinate or tangent offset of the P. S. C.

q = The distance measured along the main tangent from P. S. or P. T. to a point where the circular curve produced backward or forward becomes parallel to the main tangent.

Δ = The total central angle of the curve.

s = The central angle of the spiral from the P. S. to any given point.

S = The central angle of the whole spiral.

Ts = The tangent distance of the spiraled curve; distance from the P. S. to the P. I.

Δ_1 = $\Delta - 2S$ = Total central angle minus the sum of the central angles of the spirals.

i = The angle between the tangent at the P. S. and the chord from the P. S. to any point on the spiral or the deflection angle to any point on the spiral.

I = The angle at any point on the spiral between the tangent at that point and the chord from the P. S.

C = The chord from the P. S. to the P. S. C.

d = The degree of curve at any point on the spiral.

D = The degree of the central circular curve.

Es = External of spiraled curve.

a = The increase in degree of curve per station on the spiral = $\frac{D}{L}$.

p = The offset from the main tangents to the point where the circular curve produced backward or forward becomes parallel to the main tangent.

R = The radius of the central circular curve.

l = The length of the spiral from the P. S. to any given point.

L = The length of the spiral from the P. S. to the P. S. C.

THE STANDARD HIGHWAY SPIRAL
BASIC FORMULA

Spiral Definition

The Standard Highway Spiral is a curve whose degree varies directly as its length, beginning at zero at the P. S. and reaching a degree of curve equal to the simple curve at the P. S. C.

$$\left.\begin{array}{l} a = \dfrac{100\,D}{L}, \quad D = \dfrac{a\,L}{100}, \\ \qquad L = \dfrac{100\,D}{a} \\ S° = \dfrac{D\,L}{200}, \quad D = \dfrac{200\,S°}{L}, \\ \qquad L = \dfrac{200\,S°}{D} \end{array}\right\} \quad S = \frac{a\,L^2}{20{,}000} = \frac{D^2}{2\,a}$$

$$R = \frac{5729.5779513}{D} = \frac{5729.5779513\,L}{200\,S°} = \frac{28.647889757\,L}{S°}$$

$$\frac{X}{L} = \Sigma\left(\frac{\theta^{2n-1}}{(2n-1)\,!\,(4n-1)\,(-1)^{n+1}}\right)$$

$$\frac{Y}{L} = \Sigma\left(\frac{\theta^{2n-2}}{(2n-2)\,!\,(4n-3)\,(-1)^{n+1}}\right)$$

Following is the expanded form for values to $n = 8$ ("n" is not equal to O)

$\theta = S$ in Radians

$$X = L\left(\frac{\theta}{3} - \frac{\theta^3}{42} + \frac{\theta^5}{1320} - \frac{\theta^7}{75{,}600} + \frac{\theta^9}{6{,}894{,}720} - \frac{\theta^{11}}{918{,}086{,}400} + \frac{\theta^{13}}{168{,}129{,}561{,}600} - \frac{\theta^{15}}{40{,}537{,}905{,}408{,}000} - \cdots\right)$$

$$Y = L\left(1 - \frac{\theta^2}{10} + \frac{\theta^4}{216} - \frac{\theta^6}{9360} + \frac{\theta^8}{685{,}440} - \frac{\theta^{10}}{76{,}204{,}800} + \frac{\theta^{12}}{11{,}975{,}040{,}000} - \frac{\theta^{14}}{2{,}528{,}170{,}444{,}800} - \cdots\right)$$

$$\text{Tan } i = \frac{X}{Y}$$

$$I = S - i$$

$$p = X - R \text{ vers } S = X - \frac{28.647889757\ L}{S^\circ} \text{ vers } S$$

$$q = Y - R \sin S = Y - \frac{28.647889757\ L}{S^\circ} \sin S$$

$$U = Y - X \cot S$$

$$V = \frac{X}{\sin S} = X \csc S$$

$$C = \sqrt{X^2 + Y^2}$$

$$Ts = q + (R + p) \tan \frac{\Delta}{2}$$

$$Es = p + (R + p) \text{ exsec } \frac{\Delta}{2}$$

$\pi = 3.1415926536$

1 Radian $= 57.295779513^\circ$

The foregoing formulae for p, q, U and V, will not give consistent answers when S is less than 3°00″ because the tables available do not have enough significant figures.

Miscellaneous Formulae

1) $\tan \theta = \dfrac{\sin \theta}{\cos \theta}$

2) $\text{exsec } \theta = \sec \theta - 1 = \dfrac{1}{\cos \theta} - 1 = \dfrac{\text{vers } \theta}{\cos \theta}$

3) $\text{vers } \theta = 1 - \cos \theta$

4) Useful formulae for determining deflection angles in field on spirals (approximate) method.

Nomenclature:

i = deflection angle in minutes

a = increase in degree/station on spiral

d = distance in stations from transit for which deflection is to be computed

L^1 = distance in stations from P. S. or P. T. to any transit set up on spiral

D = degree of simple curve

a) Deflection from PS or PT to any point ahead on spiral

$i = 10\ ad^2 = \frac{1}{3}\ s$

b) Deflections from an intermediate setup on the spiral

$i = 10\ ad\ (3L^1 \pm d)$ Use + for going ahead on spiral

Use — for going back on spiral

c) Deflection from the PSC or PCS to any point back on spiral

$i = 10\ ad\ (3L - d)$ L is total spiral length

5) Deflections for circular curve (exact method)

$i = 30\ Dl = \frac{1}{2}\ S_1$

where S_1 = the central angle between any two points on the curve.

l = distance between curve points in stations.

THE STANDARD HIGHWAY SPIRAL

SPIRALS

All curves shall be spiraled, using an approximation of the Talbot Spiral based on arc definition for radius of curve. The standard length for spirals shall be as follows:

Degree of Curve	Value of "a"	Length
0°15′	0.10	250′
0°30′	0.20	250′
1°00′	0.25	400′
1°30′	0.40	375′
2°00′	0.50	400′
2°30′	0.50	500′
3°00′	0.60	500′
3°30′	0.70	500′
4°00′	0.80	500′
5°00′	1.00	500′
6°00′	1⅓	450′
7°00′	1.75	400′
8°00′	2.00	400′
10°00′	2.50	400′
12°00′	3.00	400′
14°00′	4.00	350′
16°00′	5.00	320′
18°00′	6.00	300′
20°00′	8.00	250′
24°00′	10.00	240′
30°00′	15.00	200′
36°00′	20.00	180′
40°00′	25.00	160′

For curves between those shown, the spiral length should be comparable to either the preceding or the following length given in the above table. The values of "a" or "S" can be adjusted so that either Table IV or Table V can be used without interpolation. Any deviation from the standard as set forth shall be approved by the Construction Engineer.

Note: On multilane highways with median widths that are paved and superelevated on the same plane as the travel lanes, the following factors are used to obtain the spiral length desired: 4-lanes—1.5 × above length
6-lanes—2.0 × above length

Part 1

SPIRAL TABLES

TABLE I

Radii, deflection angles and chord corrections for circular curves of "arc" definition.

N. B.—The radius of a one degree curve is 5,729.57795+ feet. To find the radii for other degree curves, divide the foregoing radius by the desired degree of curve.

TABLE I, RADII, DEFL., AND CHORDS, ARC DEFINITION

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
0.05	114,591.559	0.015	0°00.375′	0°00.750′	25.00	50.00	100.00
0.10	57,295.780	0.030	0°00.750′	0°01.500′	25.00	50.00	100.00
0.15	38,197.186	0.045	0°01.125′	0°02.250′	25.00	50.00	100.00
0.20	28,647.890	0.060	0°01.500′	0°03.000′	25.00	50.00	100.00
0.25	22,918.312	0.075	0°01.875′	0°03.750′	25.00	50.00	100.00
0.30	19,098.593	0.090	0°02.250′	0°04.500′	25.00	50.00	100.00
0.35	16,370.223	0.105	0°02.625′	0°05.250′	25.00	50.00	100.00
0.40	14,323.945	0.120	0°03.000′	0°06.000′	25.00	50.00	100.00
0.45	12,732.395	0.135	0°03.375′	0°06.750′	25.00	50.00	100.00
0.50	11,459.156	0.150	0°03.750′	0°07.500′	25.00	50.00	100.00
0.55	10,417.414	0.165	0°04.125′	0°08.250′	25.00	50.00	100.00
0.60	9,549.297	0.180	0°04.500′	0°09.000′	25.00	50.00	100.00
0.65	8,814.735	0.195	0°04.875′	0°09.750′	25.00	50.00	100.00
0.70	8,185.111	0.210	0°05.250′	0°10.500′	25.00	50.00	100.00
0.75	7,639.437	0.225	0°05.625′	0°11.250′	25.00	50.00	100.00
0.80	7,161.972	0.240	0°06.000′	0°12.000′	25.00	50.00	100.00
0.85	6.740.680	0.255	0°06.375′	0°12.750′	25.00	50.00	100.00
0.90	6,366.198	0.270	0°06.750′	0°13.500′	25.00	50.00	100.00
0.95	6,031 135	0.285	0°07.125′	0°14.250′	25.00	50.00	100.00
1.00	5.729.578	0.300	0°07.500′	0°15.000′	25.00	50.00	100.00
1.05	5,456.741	0.315	0°07.875′	0°15.750′	25.00	50.00	100.00
1.10	5.208.707	0.330	0°08.250′	0°16.500′	25.00	50.00	100.00
1.15	4.982.242	0.345	0°08.625′	0°17.250′	25.00	50.00	100.00
1.20	4.774.648	0.360	0°09.000′	0°18.000′	25.00	50.00	100.00
1.25	4.583.662	0.375	0°09.375′	0°18.750′	25.00	50.00	100.00
1.30	4.407.368	0.390	0°09.750′	0°19.500′	25.00	50.00	100.00
1.35	4,244.132	0.405	0°10.125′	0°20.250′	25.00	50.00	100.00
1.40	4,092.556	0.420	0°10.500′	0°21.000′	25.00	50.00	100.00
1.45	3,951.433	0.435	0°10.875′	0°21.750′	25.00	50.00	100.00
1.50	3,819.719	0.450	0°11.250′	0°22.500′	25.00	50.00	100.00
1.55	3.696.502	0.465	0°11.625′	0°23.250′	25.00	50.00	100.00
1.60	3,580.986	0.480	0°12.000′	0°24.000′	25.00	50.00	100.00
1.65	3,472.471	0.495	0°12.375′	0°24.750′	25.00	50.00	100.00
1.70	3.370.340	0.510	0°12.750′	0°25.500′	25.00	50.00	100.00
1.75	3,274.045	0.525	0°13.125′	0°26.250′	25.00	50.00	100.00
1.80	3,183.099	0.540	0°13.500′	0°27.000′	25.00	50.00	100.00
1.85	3.097.069	0.555	0°13.875′	0°27.750′	25.00	50.00	100.00
1.90	3,015.567	0.570	0°14.250′	0°28.500′	25.00	50.00	100.00
1.95	2,938.245	0.585	0°14.625′	0°29.250′	25.00	50.00	100.00
2.00	2,864.789	0.600	0°15.000′	0°30.000′	25.00	50.00	99.99
2.05	2,794.916	0.615	0°15.375′	0°30.750′	25.00	50.00	99.99
2.10	2,728.370	0.630	0°15.750′	0°31.500′	25.00	50.00	99.99
2.15	2,664.920	0.645	0°16.125′	0°32.250′	25.00	50.00	99.99
2.20	2.604.354	0.660	0°16.500′	0°33.000′	25.00	50.00	99.99
2.25	2.546.479	0.675	0°16.875′	0°33.750′	25.00	50.00	99.99
2.30	2,491.121	0.690	0°17.250′	0°34.500′	25.00	50.00	99.99
2.35	2,438.118	0.705	0°17.625′	0°35.250′	25.00	50.00	99.99
2.40	2,387.324	0.720	0°18.000′	0°36.000′	25.00	50.00	99.99
2.45	2,338.603	0.735	0°18.375′	0°36.750′	25.00	50.00	99.99
2.50	2,291.831	0.750	0°18.750′	0°37.500′	25.00	50.00	99.99
2.55	2,246.893	0.765	0°19.125′	0°38.250′	25.00	50.00	99.99
2.60	2,203.684	0.780	0°19.500′	0°39.000′	25.00	50.00	99.99
2.65	2,162.105	0.795	0°19.875′	0°39.750′	25.00	50.00	99.99
2.70	2,122.066	0.810	0°20.250′	0°40.500′	25.00	50.00	99.99
2.75	2,083.483	0.825	0°20.625′	0°41.250′	25.00	50.00	99.99
2.80	2,046.278	0.840	0°21.000′	0°42.000′	25.00	50.00	99.99

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
2.85	2,010.378	0.855	0°21.375′	0°42.750′	25.00	50.00	99.99
2.90	1,975.717	0.870	0°21.750′	0°43.500′	25.00	50.00	99.99
2.95	1,942.230	0.885	0°22.125′	0°44.250′	25.00	50.00	99.99
3.00	1,909.859	0.900	0°22.500′	0°45.000′	25.00	50.00	99.99
3.05	1,878.550	0.915	0°22.875′	0°45.750′	25.00	50.00	99.99
3.10	1,848.251	0.930	0°23.250′	0°46.500′	25.00	50.00	99.99
3.15	1,818.914	0.945	0°23.625′	0°47.250′	25.00	50.00	99.99
3.20	1,790.493	0.960	0°24.000′	0°48.000′	25.00	50.00	99.99
3.25	1,762.947	0.975	0°24.375′	0°48.750′	25.00	50.00	99.99
3.30	1,736.236	0.990	0°24.750′	0°49.500′	25.00	50.00	99.99
3.35	1,710.322	1.005	0°25.125′	0°50.250′	25.00	50.00	99.99
3.40	1,685.170	1.020	0°25.500′	0°51.000′	25.00	50.00	99.99
3.45	1,660.747	1.035	0°25.875′	0°51.750′	25.00	50.00	99.98
3.50	1,637.022	1.050	0°26.250′	0°52.500′	25.00	50.00	99.98
3.55	1,613.966	1.065	0°26.625′	0°53.250′	25.00	50.00	99.98
3.60	1,591.549	1.080	0°27.000′	0°54.000′	25.00	50.00	99.98
3.65	1,569.747	1.095	0°27.375′	0°54.750′	25.00	50.00	99.98
3.70	1,548.535	1.110	0°27.750′	0°55.500′	25.00	50.00	99.98
3.75	1,527.887	1.125	0°28.125′	0°56.250′	25.00	50.00	99.98
3.80	1,507.784	1.140	0°28.500′	0°57.000′	25.00	50.00	99.98
3.85	1,488.202	1.155	0°28.875′	0°57.750′	25.00	50.00	99.98
3.90	1,469.123	1.170	0°29.250′	0°58.500′	25.00	50.00	99.98
3.95	1,450.526	1.185	0°29.625′	0°59.250′	25.00	50.00	99.98
4.00	1,432.394	1.200	0°30.000′	1°00.000′	25.00	50.00	99.98
4.25	1,348.136	1.275	0°31.875′	1°03.750′	25.00	50.00	99.98
4.50	1,273.240	1.350	0°33.750′	1°07.500′	25.00	50.00	99.97
4.75	1,206.227	1.425	0°35.625′	1°11.250′	25.00	50.00	99.97
5.00	1,145.916	1.500	0°37.500′	1°15.000′	25.00	50.00	99.97
5.25	1,091.348	1.575	0°39.375′	1°18.750′	25.00	50.00	99.96
5.50	1,041.741	1.650	0°41.250′	1°22.500′	25.00	50.00	99.96
5.75	996.448	1.725	0°43.125′	1°26.250′	25.00	49.99	99.96
6.00	954.930	1.800	0°45.000′	1°30.000′	25.00	49.99	99.95
6.25	916.732	1.875	0°46.875′	1°33.750′	25.00	49.99	99.95
6.50	881.474	1.950	0°48.750′	1°37.500′	25.00	49.99	99.95
6.75	848.826	2.025	0°50.625′	1°41.250′	25.00	49.99	99.94
7.00	818.511	2.100	0°52.500′	1°45.000′	25.00	49.99	99.94
7.25	790.287	2.175	0°54.375′	1°48.750′	25.00	49.99	99.93
7.50	763.944	2.250	0°56.250′	1°52.500′	25.00	49.99	99.93
7.75	739.300	2.325	0°58.125′	1°56.250′	25.00	49.99	99.92
8.00	716.197	2.400	1°00.000′	2°00.000′	25.00	49.99	99.92
8.25	694.494	2.475	1°01.875′	2°03.750′	25.00	49.99	99.91
8.50	674.068	2.550	1°03.750′	2°07.500′	25.00	49.99	99.91
8.75	654.809	2.625	1°05.625′	2°11.250′	25.00	49.99	99.90
9.00	636.620	2.700	1°07.500′	2°15.000′	25.00	49.99	99.90
9.25	619.414	2.775	1°09.375′	2°18.750′	25.00	49.99	99.89
9.50	603.113	2.850	1°11.250′	2°22.500′	25.00	49.99	99.89
9.75	587.649	2.925	1°13.125′	2°26.250′	25.00	49.98	99.88
10.00	572.958	3.000	1°15.000′	2°30.000′	25.00	49.98	99.87
10.25	558.983	3.075	1°16.875′	2°33.750′	25.00	49.98	99.87
10.50	545.674	3.150	1°18.750′	2°37.500′	25.00	49.98	99.86
10.75	532.984	3.225	1°20.625′	2°41.250′	25.00	49.98	99.85
11.00	520.871	3.300	1°22.500′	2°45.000′	25.00	49.98	99.85
11.25	509.296	3.375	1°24.375′	2°48.750′	25.00	49.98	99.84
11.50	498.224	3.450	1°26.250′	2°52.500′	25.00	49.98	99.83
11.75	487.624	3.525	1°28.125′	2°56.250′	25.00	49.98	99.82
12.00	477.465	3.600	1°30.000′	3°00.000′	25.00	49.98	99.82
12.25	467.721	3.675	1°31.875′	3°03.750′	25.00	49.98	99.81
12.50	458.366	3.750	1°33.750′	3°07.500′	25.00	49.98	99.80
12.75	449.379	3.825	1°35.625′	3°11.250′	25.00	49.97	99.79
13.00	440.737	3.900	1°37.500′	3°15.000′	25.00	49.97	99.79

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
13.25	432.421	3.975	1°39.375′	3°18.750′	25.00	49.97	99.78
13.50	424.413	4.050	1°41.250′	3°22.500′	25.00	49.97	99.77
13.75	416.697	4.125	1°43.125′	3°26.250′	25.00	49.97	99.76
14.00	409.256	4.200	1°45.000′	3°30.000′	25.00	49.97	99.75
14.25	402.076	4.275	1°46.875′	3°33.750′	25.00	49.97	99.74
14.50	395.143	4.350	1°48.750′	3°37.500′	25.00	49.97	99.73
14.75	388.446	4.425	1°50.625′	3°41.250′	25.00	49.97	99.72
15.00	381.972	4.500	1°52.500′	3°45.000′	25.00	49.96	99.71
15.25	375.710	4.575	1°54.375′	3°48.750′	25.00	49.96	99.71
15.50	369.650	4.650	1°56.250′	3°52.500′	25.00	49.96	99.70
15.75	363.783	4.725	1°58.125′	3°56.250′	25.00	49.96	99.69
16.00	358.099	4.800	2°00.000′	4°00.000′	24.99	49.96	99.68
16.25	352.589	4.875	2°01.875′	4°03.750′	24.99	49.96	99.67
16.50	347.247	4.950	2°03.750′	4°07.500′	24.99	49.96	99.65
16.75	342.064	5.025	2°05.625′	4°11.250′	24.99	49.96	99.64
17.00	337.034	5.100	2°07.500′	4°15.000′	24.99	49.95	99.63
17.25	332.149	5.175	2°09.375′	4°18.750′	24.99	49.95	99.62
17.50	327.404	5.250	2°11.250′	4°22.500′	24.99	49.95	99.61
17.75	322.793	5.325	2°13.125′	4°26.250′	24.99	49.95	99.60
18.00	318.310	5.400	2°15.000′	4°30.000′	24.99	49.95	99.59
18.25	313.949	5.475	2°16.875′	4°33.750′	24.99	49.95	99.58
18.50	309.707	5.550	2°18.750′	4°37.500′	24.99	49.95	99.57
18.75	305.577	5.625	2°20.625′	4°41.250′	24.99	49.94	99.55
19.00	301.557	5.700	2°22.500′	4°45.000′	24.99	49.94	99.54
19.25	297.640	5.775	2°24.375′	4°48.750′	24.99	49.94	99.53
19.50	293.825	5.850	2°26.250′	4°52.500′	24.99	49.94	99.52
19.75	290.105	5.925	2°28.125′	4°56.250′	24.99	49.94	99.51
20.00	286.479	6.000	2°30.000′	5°00.000′	24.99	49.94	99.49
20.25	282.942	6.075	2°31.875′	5°03.750′	24.99	49.93	99.48
20.50	279.492	6.150	2°33.750′	5°07.500′	24.99	49.93	99.47
20.75	276.124	6.255	2°35.625′	5°11.250′	24.99	49.93	99.45
21.00	272.837	6.300	2°37.500′	5°15.000′	24.99	49.93	99.44
21.25	269.627	6.375	2°39.375′	5°18.750′	24.99	49.93	99.43
21.50	266.492	6.450	2°41.250′	5°22.500′	24.99	49.93	99.41
21.75	263.429	6.525	2°43.125′	5°26.250′	24.99	49.93	99.40
22.00	260.435	6.600	2°45.000′	5°30.000′	24.99	49.92	99.39
22.25	257.509	6.675	2°46.875′	5°33.750′	24.99	49.92	99.37
22.50	254.648	6.750	2°48.750′	5°37.500′	24.99	49.92	99.36
22.75	251.850	6.825	2°50.625′	5°41.250′	24.99	49.92	99.34
23.00	249.112	6.900	2°52.500′	5°45.000′	24.99	49.92	99.33
23.25	246.433	6.975	2°54.375′	5°48.750′	24.99	49.91	99.32
23.50	243.812	7.050	2°56.250′	5°52.500′	24.99	49.91	99.30
23.75	241.245	7.125	2°58.125′	5°56.250′	24.99	49.91	99.29
24.00	238.732	7.200	3°00.000′	6°00.000′	24.99	49.91	99.27
24.25	236.271	7.275	3°01.875′	6°03.750′	24.99	49.91	99.26
24.50	233.860	7.350	3°03.750′	6°07.500′	24.99	49.90	99.24
24.75	231.498	7.425	3°05.625′	6°11.250′	24.99	49.90	99.22
25.00	229.183	7.500	3°07.500′	6°15.000′	24.99	49.90	99.21
25.25	226.914	7.575	3°09.375′	6°18.750′	24.99	49.90	99.19
25.50	224.689	7.650	3°11.250′	6°22.500′	24.99	49.90	99.18
25.75	222.508	7.725	3°13.125′	6°26.250′	24.99	49.89	99.16
26.00	220.368	7.800	3°15.000′	6°30.000′	24.99	49.89	99.14
26.25	218.270	7.875	3°16.875′	6°33.750′	24.99	49.89	99.13
26.50	216.210	7.950	3°18.750′	6°37.500′	24.99	49.89	99.11
26.75	214.190	8.025	3°20.625′	6°41.250′	24.99	49.89	99.09
27.00	212.207	8.100	3°22.500′	6°45.000′	24.99	49.88	99.08
27.25	210.260	8.175	3°24.375′	6°48.750′	24.99	49.88	99.06
27.50	208.348	8.250	3°26.250′	6°52.500′	24.98	49.88	99.04
27.75	206.471	8.325	3°28.125′	6°56.250′	24.98	49.88	99.03
28.00	204.628	8.400	3°30.000′	7°00.000′	24.98	49.88	99.01

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
28.25	202.817	8.475	3°31.875′	7°03.750′	24.98	49.87	98.99
28.50	201.038	8.550	3°33.750′	7°07.500′	24.98	49.87	98.97
28.75	199.290	8.625	3°35.625′	7°11.250′	24.98	49.87	98.95
29.00	197.572	8.700	3°37.500′	7°15.000′	24.98	49.87	98.94
29.25	195.883	8.775	3°39.375′	7°18.750′	24.98	49.86	98.92
29.50	194.223	8.850	3°41.250′	7°22.500′	24.98	49.86	98.90
29.75	192.591	8.925	3°43.125′	7°26.250′	24.98	49.86	98.88
30.00	190.986	9.000	3°45.000′	7°30.000′	24.98	49.86	98.86
30.25	189.408	9.075	3°46.875′	7°33.750′	24.98	49.86	98.84
30.50	187.855	9.150	3°48.750′	7°37.500′	24.98	49.85	98.82
30.75	186.328	9.225	3°50.625′	7°41.250′	24.98	49.85	98.80
31.00	184.825	9.300	3°52.500′	7°45.000′	24.98	49.85	98.78
31.25	183.346	9.375	3°54.375′	7°48.750′	24.98	49.85	98.76
31.50	181.891	9.450	3°56.250′	7°52.500′	24.98	49.84	98.75
31.75	180.459	9.525	3°58.125′	7°56.250′	24.98	49.84	98.73
32.00	179.049	9.600	4°00.000′	8°00.000′	24.98	49.84	98.71
32.25	177.661	9.675	4°01.875′	8°03.750′	24.98	49.84	98.68
32.50	176.295	9.750	4°03.750′	8°07.500′	24.98	49.83	98.66
32.75	174.949	9.825	4°05.625′	8°11.250′	24.98	49.83	98.64
33.00	173.624	9.900	4°07.500′	8°15.000′	24.98	49.83	98.62
33.25	172.318	9.975	4°09.375′	8°18.750′	24.98	49.82	98.60
33.50	171.032	10.050	4°11.250′	8°22.500′	24.98	49.82	98.58
33.75	169.765	10.125	4°13.125′	8°26.250′	24.98	49.82	98.56
34.00	168.517	10.200	4°15.000′	8°30.000′	24.98	49.82	98.54
34.25	167.287	10.275	4°16.875′	8°33.750′	24.98	49.81	98.52
34.50	166.075	10.350	4°18.750′	8°37.500′	24.98	49.81	98.50
34.75	164.880	10.425	4°20.625′	8°41.250′	24.98	49.81	98.47
35.00	163.702	10.500	4°22.500′	8°45.000′	24.98	49.81	98.45
35.25	162.541	10.575	4°24.375′	8°48.750′	24.98	49.80	98.43
35.50	161.397	10.650	4°26.250′	8°52.500′	24.98	49.80	98.41
35.75	160.268	10.725	4°28.125′	8°56.250′	24.97	49.80	98.39
36.00	159.155	10.800	4°30.000′	9°00.000′	24.97	49.79	98.36
36.25	158.057	10.875	4°31.875′	9°03.750′	24.97	49.79	98.34
36.50	156.975	10.950	4°33.750′	9°07.500′	24.97	49.79	98.32
36.75	155.907	11.025	4°35.625′	9°11.250′	24.97	49.79	98.29
37.00	154.853	11.100	4°37.500′	9°15.000′	24.97	49.78	98.27
37.25	153.814	11.175	4°39.375′	9°18.750′	24.97	49.78	98.25
37.50	152.789	11.250	4°41.250′	9°22.500′	24.97	49.78	98.22
37.75	151.777	11.325	4°43.125′	9°26.250′	24.97	49.77	98.20
38.00	150.778	11.400	4°45.000′	9°30.000′	24.97	49.77	98.18
38.25	149.793	11.475	4°46.875′	9°33.750′	24.97	49.77	98.15
38.50	148.820	11.550	4°48.750′	9°37.500′	24.97	49.77	98.13
38.75	147.860	11.625	4°50.625′	9°41.250′	24.97	49.76	98.10
39.00	146.912	11.700	4°52.500′	9°45.000′	24.97	49.76	98.08
39.25	145.977	11.775	4°54.375′	9°48.750′	24.97	49.76	98.06
39.50	145.053	11.850	4°56.250′	9°52.500′	24.97	49.75	98.03
39.75	144.140	11.925	4°58.125′	9°56.250′	24.97	49.75	98.01
40.00	143.239	12.000	5°00.000′	10°00.000′	24.97	49.75	97.98
40.25	142.350	12.075	5°01.875′	10°03.750′	24.97	49.74	97.96
40.50	141.471	12.150	5°03.750′	10°07.500′	24.97	49.74	97.93
40.75	140.603	12.225	5°05.625′	10°11.250′	24.97	49.74	97.91
41.00	139.746	12.300	5°07.500′	10°15.000′	24.97	49.73	97.88
41.25	138.899	12.375	5°09.375′	10°18.750′	24.97	49.73	97.85
41.50	138.062	12.450	5°11.250′	10°22.500′	24.97	49.73	97.83
41.75	137.235	12.525	5°13.125′	10°26.250′	24.97	49.72	97.80
42.00	136.419	12.600	5°15.000′	10°30.000′	24.97	49.72	97.78
42.25	135.611	12.675	5°16.875′	10°33.750′	24.96	49.72	97.75
42.50	134.814	12.750	5°18.750′	10°37.500′	24.96	49.71	97.72
42.75	134.025	12.825	5°20.625′	10°41.250′	24.96	49.71	97.70
43.00	133.246	12.900	5°22.500′	10°45.000′	24.96	49.71	97.67

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
43.25	132.476	12.975	5°24.375′	10°48.750′	24.96	49.70	97.64
43.50	131.714	13.050	5°26.250′	10°52.500′	24.96	49.70	97.62
43.75	130.962	13.125	5°28.125′	10°56.250′	24.96	49.70	97.59
44.00	130.218	13.200	5°30.000′	11°00.000′	24.96	49.69	97.56
44.25	129.482	13.275	5°31.875′	11°03.750′	24.96	49.69	97.53
44.50	128.755	13.350	5°33.750′	11°07.500′	24.96	49.69	97.51
44.75	128.035	13.425	5°35.625′	11°11.250′	24.96	49.68	97.48
45.00	127.324	13.500	5°37.500′	11°15.000′	24.96	49.68	97.45
45.25	126.621	13.575	5°39.375′	11°18.750′	24.96	49.68	97.42
45.50	125.925	13.650	5°41.250′	11°22.500′	24.96	49.67	97.39
45.75	125.237	13.725	5°43.125′	11°26.250′	24.96	49.67	97.36
46.00	124.556	13.800	5°45.000′	11°30.000′	24.96	49.66	97.34
46.25	123.883	13.875	5°46.875′	11°33.750′	24.96	49.66	97.31
46.50	123.217	13.950	5°48.750′	11°37.500′	24.96	49.66	97.28
46.75	122.558	14.025	5°50.625′	11°41.250′	24.96	49.65	97.25
47.00	121.906	14.100	5°52.500′	11°45.000′	24.96	49.65	97.22
47.25	121.261	14.175	5°54.375′	11°48.750′	24.96	49.65	97.19
47.50	120.623	14.250	5°56.250′	11°52.500′	24.96	49.64	97.16
47.75	119.991	14.325	5°58.125′	11°56.250′	24.95	49.64	97.13
48.00	119.366	14.400	6°00.000′	12°00.000′	24.95	49.64	97.10
48.25	118.748	14.475	6°01.875′	12°03.750′	24.95	49.63	97.07
48.50	118.136	14.550	6°03.750′	12°07.500′	24.95	49.63	97.04
48.75	117.530	14.625	6°05.625′	12°11.250′	24.95	49.62	97.01
49.00	116.930	14.700	6°07.500′	12°15.000′	24.95	49.62	96.98
49.25	116.337	14.775	6°09.375′	12°18.750′	24.95	49.62	96.95
49.50	115.749	14.850	6°11.250′	12°22.500′	24.95	49.61	96.92
49.75	115.167	14.925	6°13.125′	12°26.250′	24.95	49.61	96.89
50.00	114.592	15.000	6°15.000′	12°30.000′	24.95	49.60	96.86
50.25	114.021	15.075	6°16.875′	12°33.750′	24.95	49.60	96.83
50.50	113.457	15.150	6°18.750′	12°37.500′	24.95	49.60	96.79
50.75	112.898	15.225	6°20.625′	12°41.250′	24.95	49.59	96.76
51.00	112.345	15.300	6°22.500′	12°45.000′	24.95	49.59	96.73
51.25	111.797	15.375	6°24.375′	12°48.750′	24.95	49.58	96.70
51.50	111.254	15.450	6°26.250′	12°52.500′	24.95	49.58	96.67
51.75	110.716	15.525	6°28.125′	12°56.250′	24.95	49.58	96.63
52.00	110.184	15.600	6°30.000′	13°00.000′	24.95	49.57	96.60
52.25	109.657	15.675	6°31.875′	13°03.750′	24.95	49.57	96.57
52.50	109.135	15.750	6°33.750′	13°07.500′	24.95	49.56	96.54
52.75	108.618	15.825	6°35.625′	13°11.250′	24.94	49.56	96.51
53.00	108.105	15.900	6°37.500′	13°15.000′	24.94	49.56	96.47
53.25	107.598	15.975	6°39.375′	13°18.750′	24.94	49.55	96.44
53.50	107.095	16.050	6°41.250′	13°22.500′	24.94	49.55	96.41
53.75	106.597	16.125	6°43.125′	13°26.250′	24.94	49.54	96.37
54.00	106.103	16.200	6°45.000′	13°30.000′	24.94	49.54	96.34
54.25	105.614	16.275	6°46.875′	13°33.750′	24.94	49.53	96.31
54.50	105.130	16.350	6°48.750′	13°37.500′	24.94	49.53	96.27
54.75	104.650	16.425	6°50.625′	13°41.250′	24.94	49.53	96.24
55.00	104.174	16.500	6°52.500′	13°45.000′	24.94	49.52	96.20
55.25	103.703	16.575	6°54.375′	13°48.750′	24.94	49.52	96.17
55.50	103.236	16.650	6°56.250′	13°52.500′	24.94	49.51	96.14
55.75	102.773	16.725	6°58.125′	13°56.250′	24.94	49.51	96.10
56.00	102.314	16.800	7°00.000′	14°00.000′	24.94	49.50	96.07
56.25	101.859	16.875	7°01.875′	14°03.750′	24.94	49.50	96.03
56.50	101.408	16.950	7°03.750′	14°07.500′	24.94	49.49	96.00
56.75	100.962	17.025	7°05.625′	14°11.250′	24.94	49.49	95.96
57.00	100.519	17.100	7°07.500′	14°15.000′	24.94	49.49	95.93
57.25	100.080	17.175	7°09.375′	14°18.750′	24.94	49.48	95.89
57.50	99.645	17.250	7°11.250′	14°22.500′	24.93	49.48	95.86
57.75	99.213	17.325	7°13.125′	14°26.250′	24.93	49.47	95.82
58.00	98.786	17.400	7°15.000′	14°30.000′	24.93	49.47	95.78

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
58.25	98.362	17.475	7°16.875′	14°33.750′	24.93	49.46	95.75
58.50	97.942	17.550	7°18.750′	14°37.500′	24.93	49.46	95.71
58.75	97.525	17.625	7°20.625′	14°41.250′	24.93	49.45	95.68
59.00	97.111	17.700	7°22.500′	14°45.000′	24.93	49.45	95.64
59.25	96.702	17.775	7°24.375′	14°48.750′	24.93	49.45	95.60
59.50	96.295	17.850	7°26.250′	14°52.500′	24.93	49.44	95.57
59.75	95.893	17.925	7°28.125′	14°56.250′	24.93	49.44	95.53
60.00	95.493	18.000	7°30.000′	15°00.000′	24.93	49.43	95.49
60.25	95.097	18.075	7°31.875′	15°03.750′	24.93	49.43	95.46
60.50	94.704	18.150	7°33.750′	15°07.500′	24.93	49.42	95.42
60.75	94.314	18.225	7°35.625′	15°11.250′	24.93	49.42	95.38
61.00	93.928	18.300	7°37.500′	15°15.000′	24.93	49.41	95.34
61.25	93.544	18.375	7°39.375′	15°18.750′	24.93	49.41	95.31
61.50	93.164	18.450	7°41.250′	15°22.500′	24.93	49.40	95.27
61.75	92.787	18.525	7°43.125′	15°26.250′	24.92	49.40	95.23
62.00	92.413	18.600	7°45.000′	15°30.000′	24.92	49.39	95.19
62.25	92.041	18.675	7°46.875′	15°33.750′	24.92	49.39	95.15
62.50	91.673	18.750	7°48.750′	15°37.500′	24.92	49.38	95.12
62.75	91.308	18.825	7°50.625′	15°41.250′	24.92	49.38	95.08
63.00	90.946	18.900	7°52.500′	15°45.000′	24.92	49.37	95.04
63.25	90.586	18.975	7°54.375′	15°48.750′	24.92	49.37	95.00
63.50	90.230	19.050	7°56.250′	15°52.500′	24.92	49.36	94.96
63.75	89.876	19.125	7°58.125′	15°56.250′	24.92	49.36	94.92
64.00	89.525	19.200	8°00.000′	16°00.000′	24.92	49.35	94.88
64.25	89.176	19.275	8°01.875′	16°03.750′	24.92	49.35	94.84
64.50	88.831	19.350	8°03.750′	16°07.500′	24.92	49.34	94.80
64.75	88.488	19.425	8°05.625′	16°11.250′	24.92	49.34	94.76
65.00	88.147	19.500	8°07.500′	16°15.000′	24.92	49.33	94.72
65.25	87.810	19.575	8°09.375′	16°18.750′	24.92	49.33	94.68
65.50	87.474	19.650	8°11.250′	16°22.500′	24.91	49.32	94.64
65.75	87.142	19.725	8°13.125′	16°26.250′	24.91	49.32	94.60
66.00	86.812	19.800	8°15.000′	16°30.000′	24.91	49.31	94.56
66.25	86.484	19.875	8°16.875′	16°33.750′	24.91	49.31	94.52
66.50	86.159	19.950	8°18.750′	16°37.500′	24.91	49.30	94.48
66.75	85.836	20.025	8°20.625′	16°41.250′	24.91	49.30	94.44
67.00	85.516	20.100	8°22.500′	16°45.000′	24.91	49.29	94.40
67.25	85.198	20.175	8°24.375′	16°48.750′	24.91	49.29	94.36
67.50	84.883	20.250	8°26.250′	16°52.500′	24.91	49.28	94.32
67.75	84.569	20.325	8°28.125′	16°56.250′	24.91	49.27	94.27
68.00	84.258	20.400	8°30.000′	17°00.000′	24.91	49.27	94.23
68.25	83.950	20.475	8°31.875′	17°03.750′	24.91	49.26	94.19
68.50	83.643	20.550	8°33.750′	17°07.500′	24.91	49.26	94.15
68.75	83.339	20.625	8°35.625′	17°11.250′	24.91	49.25	94.11
69.00	83.037	20.700	8°37.500′	17°15.000′	24.91	49.25	94.07
69.25	82.738	20.775	8°39.375′	17°18.750′	24.91	49.24	94.02
69.50	82.440	20.850	8°41.250′	17°22.500′	24.90	49.24	93.98
69.75	82.144	20.925	8°43.125′	17°26.250′	24.90	49.23	93.94
70.00	81.851	21.000	8°45.000′	17°30.000′	24.90	49.23	93.90
70.25	81.560	21.075	8°46.875′	17°33.750′	24.90	49.22	93.85
70.50	81.271	21.150	8°48.750′	17°37.500′	24.90	49.22	93.81
70.75	80.983	21.225	8°50.625′	17°41.250′	24.90	49.21	93.77
71.00	80.698	21.300	8°52.500′	17°45.000′	24.90	49.20	93.72
71.25	80.415	21.375	8°54.375′	17°48.750′	24.90	49.20	93.68
71.50	80.134	21.450	8°56.250′	17°52.500′	24.90	49.19	93.64
71.75	79.855	21.525	8°58.125′	17°56.250′	24.90	49.19	93.59
72.00	79.577	21.600	9°00.000′	18°00.000′	24.90	49.18	93.55
72.25	79.302	21.675	9°01.875′	18°03.750′	24.90	49.18	93.50
72.50	79.029	21.750	9°03.750′	18°07.500′	24.90	49.17	93.46
72.75	78.757	21.825	9°05.625′	18°11.250′	24.90	49.16	93.42
73.00	78.487	21.900	9°07.500′	18°15.000′	24.89	49.16	93.37

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
73.25	78.219	21.975	9°09.375′	18°18.750′	24.89	49.15	93.33
73.50	77.953	22.050	9°11.250′	18°22.500′	24.89	49.15	93.28
73.75	77.689	22.125	9°13.125′	18°26.250′	24.89	49.14	93.24
74.00	77.427	22.200	9°15.000′	18°30.000′	24.89	49.14	93.19
74.25	77.166	22.275	9°16.875′	18°33.750′	24.89	49.13	93.15
74.50	76.907	22.350	9°18.750′	18°37.500′	24.89	49.12	93.10
74.75	76.650	22.425	9°20.625′	18°41.250′	24.89	49.12	93.06
75.00	76.394	22.500	9°22.500′	18°45.000′	24.89	49.11	93.01
75.25	76.141	22.575	9°24.375′	18°48.750′	24.89	49.11	92.97
75.50	75.888	22.650	9°26.250′	18°52.500′	24.89	49.10	92.92
75.75	75.638	22.725	9°28.125′	18°56.250′	24.89	49.09	92.87
76.00	75.389	22.800	9°30.000′	19°00.000′	24.89	49.09	92.83
76.25	75.142	22.875	9°31.875′	19°03.750′	24.88	49.08	92.78
76.50	74.896	22.950	9°33.750′	19°07.500′	24.88	49.08	92.74
76.75	74.652	23.025	9°35.625′	19°11.250′	24.88	49.07	92.69
77.00	74.410	23.100	9°37.500′	19°15.000′	24.88	49.06	92.64
77.25	74.169	23.175	9°39.375′	19°18.750′	24.88	49.06	92.60
77.50	73.930	23.250	9°41.250′	19°22.500′	24.88	49.05	92.55
77.75	73.692	23.325	9°43.125′	19°26.250′	24.88	49.05	92.50
78.00	73.456	23.400	9°45.000′	19°30.000′	24.88	49.04	92.45
78.25	73.221	23.475	9°46.875′	19°33.750′	24.88	49.03	92.41
78.50	72.988	23.550	9°48.750′	19°37.500′	24.88	49.03	92.36
78.75	72.757	23.625	9°50.625′	19°41.250′	24.88	49.02	92.31
79.00	72.526	23.700	9°52.500′	19°45.000′	24.88	49.02	92.26
79.25	72.298	23.775	9°54.375′	19°48.750′	24.88	49.01	92.22
79.50	72.070	23.850	9°56.250′	19°52.500′	24.87	49.00	92.17
79.75	71.844	23.925	9°58.125′	19°56.250′	24.87	49.00	92.12
80.00	71.620	24.000	10°00.000′	20°00.000′	24.87	48.99	92.07
80.25	71.397	24.075	10°01.875′	20°03.750′	24.87	48.98	92.02
80.50	71.175	24.150	10°03.750′	20°07.500′	24.87	48.98	91.98
80.75	70.955	24.225	10°05.625′	20°11.250′	24.87	48.97	91.93
81.00	70.736	24.300	10°07.500′	20°15.000′	24.87	48.97	91.88
81.25	70.518	24.375	10°09.375′	20°18.750′	24.87	48.96	91.83
81.50	70.302	24.450	10°11.250′	20°22.500′	24.87	48.95	91.78
81.75	70.087	24.525	10°13.125′	20°26.250′	24.87	48.95	91.73
82.00	69.873	24.600	10°15.000′	20°30.000′	24.87	48.94	91.68
82.25	69.661	24.675	10°16.875′	20°33.750′	24.87	48.93	91.63
82.50	69.449	24.750	10°18.750′	20°37.500′	24.87	48.93	91.58
82.75	69.240	24.825	10°20.625′	20°41.250′	24.86	48.92	91.53
83.00	69.031	24.900	10°22.500′	20°45.000′	24.86	48.91	91.48
83.25	68.824	24.975	10°24.375′	20°48.750′	24.86	48.91	91.43
83.50	68.618	25.050	10°26.250′	20°52.500′	24.86	48.90	91.38
83.75	68.413	25.125	10°28.125′	20°56.250′	24.86	48.89	91.33
84.00	68.209	25.200	10°30.000′	21°00.000′	24.86	48.89	91.28
84.25	68.007	25.275	10°31.875′	21°03.750′	24.86	48.88	91.23
84.50	67.806	25.350	10°33.750′	21°07.500′	24.86	48.88	91.18
84.75	67.606	25.425	10°35.625′	21°11.250′	24.86	48.87	91.13
85.00	67.407	25.500	10°37.500′	21°15.000′	24.86	48.86	91.08
85.25	67.209	25.575	10°39.375′	21°18.750′	24.86	48.85	91.03
85.50	67.013	25.650	10°41.250′	21°22.500′	24.86	48.85	90.98
85.75	66.817	25.725	10°43.125′	21°26.250′	24.85	48.84	90.92
86.00	66.623	25.800	10°45.000′	21°30.000′	24.85	48.83	90.87
86.25	66.430	25.875	10°46.875′	21°33.750′	24.85	48.83	90.82
86.50	66.238	25.950	10°48.750′	21°37.500′	24.85	48.82	90.77
86.75	66.047	26.025	10°50.625′	21°41.250′	24.85	48.81	90.72
87.00	65.857	26.100	10°52.500′	21°45.000′	24.85	48.81	90.67
87.25	65.669	26.175	10°54.375′	21°48.750′	24.85	48.80	90.61
87.50	65.481	26.250	10°56.250′	21°52.500′	24.85	48.79	90.56
87.75	65.294	26.325	10°58.125′	21°56.250′	24.85	48.79	90.51
88.00	65.109	26.400	11°00.000′	22°00.000′	24.85	48.78	90.46

Deg.	Radius	Defl. Min. 1′ Arc	Defl. Deg. and Min. 25′ Arc	Defl. Deg. and Min. 50′ Arc	Chord 25′ Arc	Chord 50′ Arc	Chord 100′ Arc
88.25	64.924	26.475	11°01.875′	22°03.750′	24.85	48.77	90.40
88.50	64.741	26.550	11°03.750′	22°07.500′	24.84	48.77	90.35
88.75	64.559	26.625	11°05.625′	22°11.250′	24.84	48.76	90.30
89.00	64.377	26.700	11°07.500′	22°15.000′	24.84	48.75	90.24
89.25	64.197	26.775	11°09.375′	22°18.750′	24.84	48.75	90.19
89.50	64.018	26.850	11°11.250′	22°22.500′	24.84	48.74	90.14
89.75	63.839	26.925	11°13.125′	22°26.250′	24.84	48.73	90.08
90.00	63.662	27.000	11°15.000′	22°30.000′	24.84	48.72	90.03
90.25	63.486	27.075	11°16.875′	22°33.750′	24.84	48.72	89.98
90.50	63.310	27.150	11°18.750′	22°37.500′	24.84	48.71	89.92
90.75	63.136	27.225	11°20.625′	22°41.250′	24.84	48.70	89.87
91.00	62.962	27.300	11°22.500′	22°45.000′	24.84	48.70	89.82
91.25	62.790	27.375	11°24.375′	22°48.750′	24.84	48.69	89.76
91.50	62.618	27.450	11°26.250′	22°52.500′	24.83	48.68	89.71
91.75	62.448	27.525	11°28.125′	22°56.250′	24.83	48.68	89.65
92.00	62.278	27.600	11°30.000′	23°00.000′	24.83	48.67	89.60
92.25	62.109	27.675	11°31.875′	23°03.750′	24.83	48.66	89.54
92.50	61.941	27.750	11°33.750′	23°07.500′	24.83	48.65	89.49
92.75	61.774	27.825	11°35.625′	23°11.250′	24.83	48.65	89.43
93.00	61.608	27.900	11°37.500′	23°15.000′	24.83	48.64	89.38
93.25	61.443	27.975	11°39.375′	23°18.750′	24.83	48.63	89.32
93.50	61.279	28.050	11°41.250′	23°22.500′	24.83	48.62	89.27
93.75	61.115	28.125	11°43.125′	23°26.250′	24.83	48.62	89.21
94.00	60.953	28.200	11°45.000′	23°30.000′	24.83	48.61	89.16
94.25	60.791	28.275	11°46.875′	23°33.750′	24.82	48.60	89.10
94.50	60.630	28.350	11°48.750′	23°37.500′	24.82	48.59	89.04
94.75	60.470	28.425	11°50.625′	23°41.250′	24.82	48.59	88.99
95.00	60.311	28.500	11°52.500′	23°45.000′	24.82	48.58	88.93
95.25	60.153	28.575	11°54.375′	23°48.750′	24.82	48.57	88.88
95.50	59.996	28.650	11°56.250′	23°52.500′	24.82	48.57	88.82
95.75	59.839	28.725	11°58.125′	23°56.250′	24.82	48.56	88.76
96.00	59.683	28.800	12°00.000′	24°00.000′	24.82	48.55	88.71
96.25	59.528	28.875	12°01.875′	24°03.750′	24.82	48.54	88.65
96.50	59.374	28.950	12°03.750′	24°07.500′	24.82	48.54	88.59
96.75	59.220	29.025	12°05.625′	24°11.250′	24.81	48.53	88.53
97.00	59.068	29.100	12°07.500′	24°15.000′	24.81	48.52	88.48
97.25	58.916	29.175	12°09.375′	24°18.750′	24.81	48.51	88.42
97.50	58.765	29.250	12°11.250′	24°22.500′	24.81	48.51	88.36
97.75	58.615	29.325	12°13.125′	24°26.250′	24.81	48.50	88.31
98.00	58.465	29.400	12°15.000′	24°30.000′	24.81	48.49	88.25
98.25	58.316	29.475	12°16.875′	24°33.750′	24.81	48.48	88.19
98.50	58.168	29.550	12°18.750′	24°37.500′	24.81	48.47	88.13
98.75	58.021	29.625	12°20.625′	24°41.250′	24.81	48.47	88.07
99.00	57.875	29.700	12°22.500′	24°45.000′	24.81	48.46	88.02
99.25	57.729	29.775	12°24.375′	24°48.750′	24.81	48.45	87.96
99.50	57.584	29.850	12°26.250′	24°52.500′	24.80	48.44	87.90
99.75	57.439	29.925	12°28.125′	24°56.250′	24.80	48.44	87.84
100.00	57.296	30.000	12°30.000′	25°00.000′	24.80	48.43	87.78

TABLE II
DEFLECTION UNIT TABLE

Giving deflection angles "i" from P. S. to any other point on the spiral, and other functions for $a = 1$. Multiply values in table by the value of "a" in the particular problem to obtain the desired data.

The correction, "n", has been applied to values of "i" for $a = 1$. Since the correction varies approximately as "S^3" and "S" varies with "a", the values of i and I obtained will be slightly in error for some values of "a" on long spirals.

The exact value of "n" in the formula $i = \frac{1}{3} S - n$ can be obtained from the following table where $n = \frac{1}{3} S - \tan^{-1} \frac{x}{y}$. It may be approximated by n (in minutes) $= 0.000052\ S^3$ ("S" in degrees).

S°	n′	S°	n′	S°	n′	S°	n′	S°	n′
1	0.0001	21	0.4794	41	3.5993	61	12.0369	81	28.7992
2	0.0004	22	0.5513	42	3.8715	62	12.6505	82	29.9166
3	0.0014	23	0.6302	43	4.1573	63	13.2850	83	31.0640
4	0.0034	24	0.7162	44	4.4570	64	13.9411	84	32.2418
5	0.0065	25	0.8097	45	4.7711	65	14.6192	85	33.4507
6	0.0112	26	0.9112	46	5.0997	66	15.3195	86	34.6911
7	0.0178	27	1.0208	47	5.4435	67	16.0426	87	35.9633
8	0.0265	28	1.1389	48	5.8024	68	16.7890	88	37.2683
9	0.0377	29	1.2659	49	6.1772	69	17.5589	89	38.6062
10	0.0517	30	1.4020	50	6.5681	70	18.3528	90	39.9777
11	0.0688	31	1.5476	51	6.9754	71	19.1713	91	41.3834
12	0.0894	32	1.7030	52	7.3995	72	20.0145	92	42.8236
13	0.1136	33	1.8685	53	7.8409	73	20.8832	93	44.2991
14	0.1419	34	2.0446	54	8.2998	74	21.7776	94	45.8103
15	0.1745	35	2.2315	55	8.7767	75	22.6983	95	47.3578
16	0.2118	36	2.4296	56	9.2719	76	23.6457	96	48.9421
17	0.2541	37	2.6391	57	9.7859	77	24.6202	97	50.5639
18	0.3017	38	2.8605	58	10.3190	78	25.6224	98	52.2236
19	0.3549	39	3.0942	59	10.8717	79	26.6526	99	53.9220
20	0.4140	40	3.3402	60	11.4441	80	27.7114	100	55.6595

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
0.01	0°00.6′	0.003	0.001	0.002
0.02	0°01.2′	0.012	0.004	0.008
0.03	0°01.8′	0.027	0.009	0.018
0.04	0°02.4′	0.048	0.016	0.032
0.05	0°03.0′	0.075	0.025	0.050
0.06	0°03.6′	0.108	0.036	0.072
0.07	0°04.2′	0.147	0.049	0.098
0.08	0°04.8′	0.192	0.064	0.128
0.09	0°05.4′	0.243	0.081	0.162
0.10	0°06.0′	0.300	0.100	0.200
0.11	0°06.6′	0.363	0.121	0.242
0.12	0°07.2′	0.432	0.144	0.288
0.13	0°07.8′	0.507	0.169	0.338
0.14	0°08.4′	0.588	0.196	0.392
0.15	0°09.0′	0.675	0.225	0.450
0.16	0°09.6′	0.768	0.256	0.512
0.17	0°10.2′	0.867	0.289	0.578
0.18	0°10.8′	0.972	0.324	0.648
0.19	0°11.4′	1.083	0.361	0.722
0.20	0°12.0′	1.200	0.400	0.800
0.21	0°12.6′	1.323	0.441	0.882
0.22	0°13.2′	1.452	0.484	0.968
0.23	0°13.8′	1.587	0.529	1.058
0.24	0°14.4′	1.728	0.576	1.152
0.25	0°15.0′	1.875	0.625	1.250
0.26	0°15.6′	2.028	0.676	1.352
0.27	0°16.2′	2.187	0.729	1.458
0.28	0°16.8′	2.352	0.784	1.568
0.29	0°17.4′	2.523	0.841	1.682
0.30	0°18.0′	2.700	0.900	1.800
0.31	0°18.6′	2.883	0.961	1.922
0.32	0°19.2′	3.072	1.024	2.048
0.33	0°19.8′	3.267	1.089	2.178
0.34	0°20.4′	3.468	1.156	2.312
0.35	0°21.0′	3.675	1.225	2.450
0.36	0°21.6′	3.888	1.296	2.592
0.37	0°22.2′	4.107	1.369	2.738
0.38	0°22.8′	4.332	1.444	2.888
0.39	0°23.4′	4.563	1.521	3.042
0.40	0°24.0′	4.800	1.600	3.200
0.41	0°24.6′	5.043	1.681	3.362
0.42	0°25.2′	5.292	1.764	3.528
0.43	0°25.8′	5.547	1.849	3.698
0.44	0°26.4′	5.808	1.936	3.872
0.45	0°27.0′	6.075	2.025	4.050
0.46	0°27.6′	6.348	2.116	4.232
0.47	0°28.2′	6.627	2.209	4.418
0.48	0°28.8′	6.912	2.304	4.608
0.49	0°29.4′	7.203	2.401	4.802
0.50	0°30.0′	7.500	2.500	5.000
0.51	0°30.6′	7.803	2.601	5.202
0.52	0°31.2′	8.112	2.704	5.408
0.53	0°31.8′	8.427	2.809	5.618
0.54	0°32.4′	8.748	2.916	5.832
0.55	0°33.0′	9.075	3.025	6.050
0.56	0°33.6′	9.408	3.136	6.272
0.57	0°34.2′	9.747	3.249	6.498
0.58	0°34.8′	10.092	3.364	6.728
0.59	0°35.4′	10.443	3.481	6.962

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
0.60	0°36.0′	10.800	3.600	7.200
0.61	0°36.6′	11.163	3.721	7.442
0.62	0°37.2′	11.532	3.844	7.688
0.63	0°37.8′	11.907	3.969	7.938
0.64	0°38.4′	12.288	4.096	8.192
0.65	0°39.0′	12.675	4.225	8.450
0.66	0°39.6′	13.068	4.356	8.712
0.67	0°40.2′	13.467	4.489	8.978
0.68	0°40.8′	13.872	4.624	9.248
0.69	0°41.4′	14.283	4.761	9.522
0.70	0°42.0′	14.700	4.900	9.800
0.71	0°42.6′	15.123	5.041	10.082
0.72	0°43.2′	15.552	5.184	10.368
0.73	0°43.8′	15.987	5.329	10.658
0.74	0°44.4′	16.428	5.476	10.952
0.75	0°45.0′	16.875	5.625	11.250
0.76	0°45.6′	17.328	5.776	11.552
0.77	0°46.2′	17.787	5.929	11.858
0.78	0°46.8′	18.252	6.084	12.168
0.79	0°47.4′	18.723	6.241	12.482
0.80	0°48.0′	19.200	6.400	12.800
0.81	0°48.6′	19.683	6.561	13.122
0.82	0°49.2′	20.172	6.724	13.448
0.83	0°49.8′	20.667	6.889	13.778
0.84	0°50.4′	21.168	7.056	14.112
0.85	0°51.0′	21.675	7.225	14.450
0.86	0°51.6′	22.188	7.396	14.792
0.87	0°52.2′	22.707	7.569	15.138
0.88	0°52.8′	23.232	7.744	15.488
0.89	0°53.4′	23.763	7.921	15.842
0.90	0°54.0′	24.300	8.100	16.200
0.91	0°54.6′	24.843	8.281	16.562
0.92	0°55.2′	25.392	8.464	16.928
0.93	0°55.8′	25.947	8.649	17.298
0.94	0°56.4′	26.508	8.836	17.672
0.95	0°57.0′	27.075	9.025	18.050
0.96	0°57.6′	27.648	9.216	18.432
0.97	0°58.2′	28.227	9.409	18.818
0.98	0°58.8′	28.812	9.604	19.208
0.99	0°59.4′	29.403	9.801	19.602
1.00	1°00.0′	30.000	10.000	20.000
1.01	1°00.6′	30.603	10.201	20.402
1.02	1°01.2′	31.212	10.404	20.808
1.03	1°01.8′	31.827	10.609	21.218
1.04	1°02.4′	32.448	10.816	21.632
1.05	1°03.0′	33.075	11.025	22.050
1.06	1°03.6′	33.708	11.236	22.472
1.07	1°04.2′	34.347	11.449	22.898
1.08	1°04.8′	34.992	11.664	23.328
1.09	1°05.4′	35.643	11.881	23.762
1.10	1°06.0′	36.300	12.100	24.200
1.11	1°06.6′	36.963	12.321	24.642
1.12	1°07.2′	37.632	12.544	25.088
1.13	1°07.8′	38.307	12.769	25.538
1.14	1°08.4′	38.988	12.996	25.992
1.15	1°09.0′	39.675	13.225	26.450
1.16	1°09.6′	40.368	13.456	26.912
1.17	1°10.2′	41.067	13.689	27.378
1.18	1°10.8′	41.772	13.924	27.848
1.19	1°11.4′	42.483	14.161	28.322

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
1.20	1°12.0′	43.200	14.400	28.800
1.21	1°12.6′	43.923	14.641	29.282
1.22	1°13.2′	44.652	14.884	29.768
1.23	1°13.8′	45.387	15.129	30.258
1.24	1°14.4′	46.128	15.376	30.752
1.25	1°15.0′	46.875	15.625	31.250
1.26	1°15.6′	47.628	15.876	31.752
1.27	1°16.2′	48.387	16.129	32.258
1.28	1°16.8′	49.152	16.384	32.768
1.29	1°17.4′	49.923	16.641	33.282
1.30	1°18.0′	50.700	16.900	33.800
1.31	1°18.6′	51.483	17.161	34.322
1.32	1°19.2′	52.272	17.424	34.848
1.33	1°19.8′	53.067	17.689	35.378
1.34	1°20.4′	53.868	17.956	35.912
1.35	1°21.0′	54.675	18.225	36.450
1.36	1°21.6′	55.488	18.496	36.992
1.37	1°22.2′	56.307	18.769	37.538
1.38	1°22.8′	57.132	19.044	38.088
1.39	1°23.4′	57.963	19.321	38.642
1.40	1°24.0′	58.800	19.600	39.200
1.41	1°24.6′	59.643	19.881	39.762
1.42	1°25.2′	60.492	20.164	40.328
1.43	1°25.8′	61.347	20.449	40.898
1.44	1°26.4′	62.208	20.736	41.472
1.45	1°27.0′	63.075	21.025	42.050
1.46	1°27.6′	63.948	21.316	42.632
1.47	1°28.2′	64.827	21.609	43.218
1.48	1°28.8′	65.712	21.904	43.808
1.49	1°29.4′	66.603	22.201	44.402
1.50	1°30.0′	67.500	22.500	45.000
1.51	1°30.6′	68.403	22.801	45.602
1.52	1°31.2′	69.312	23.104	46.208
1.53	1°31.8′	70.227	23.409	46.818
1.54	1°32.4′	71.148	23.716	47.432
1.55	1°33.0′	72.075	24.025	48.050
1.56	1°33.6′	73.008	24.336	48.672
1.57	1°34.2′	73.947	24.649	49.298
1.58	1°34.8′	74.892	24.964	49.928
1.59	1°35.4′	75.843	25.281	50.562
1.60	1°36.0′	76.800	25.600	51.200
1.61	1°36.6′	77.763	25.921	51.842
1.62	1°37.2′	78.732	26.244	52.488
1.63	1°37.8′	79.707	26.569	53.138
1.64	1°38.4′	80.688	26.896	53.792
1.65	1°39.0′	81.675	27.225	54.450
1.66	1°39.6′	82.668	27.556	55.112
1.67	1°40.2′	83.667	27.889	55.778
1.68	1°40.8′	84.672	28.224	56.448
1.69	1°41.4′	85.683	28.561	57.122
1.70	1°42.0′	86.700	28.900	57.800
1.71	1°42.6′	87.723	29.241	58.482
1.72	1°43.2′	88.752	29.584	59.168
1.73	1°43.8′	89.787	29.929	59.858
1.74	1°44.4′	90.828	30.276	60.552
1.75	1°45.0′	91.875	30.625	61.250
1.76	1°45.6′	92.928	30.976	61.952
1.77	1°46.2′	93.987	31.329	62.658
1.78	1°46.8′	95.052	31.684	63.368
1.79	1°47.4′	96.123	32.041	64.082

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
1.80	1°48.0′	97.200	32.400	64.800
1.81	1°48.6′	98.283	32.761	65.522
1.82	1°49.2′	99.372	33.124	66.248
1.83	1°49.8′	100.467	33.489	66.978
1.84	1°50.4′	101.568	33.856	67.712
1.85	1°51.0′	102.675	34.225	68.450
1.86	1°51.6′	103.788	34.596	69.192
1.87	1°52.2′	104.907	34.969	69.938
1.88	1°52.8′	106.032	35.344	70.688
1.89	1°53.4′	107.163	35.721	71.442
1.90	1°54.0′	108.300	36.100	72.200
1.91	1°54.6′	109.443	36.481	72.962
1.92	1°55.2′	110.592	36.864	73.728
1.93	1°55.8′	111.747	37.249	74.498
1.94	1°56.4′	112.908	37.636	75.272
1.95	1°57.0′	114.075	38.025	76.050
1.96	1°57.6′	115.248	38.416	76.832
1.97	1°58.2′	116.427	38.809	77.618
1.98	1°58.8′	117.612	39.204	78.408
1.99	1°59.4′	118.803	39.601	79.202
2.00	2°00.0′	120.000	40.000	80.000
2.01	2°00.6′	121.203	40.400	80.802
2.02	2°01.2′	122.412	40.803	81.609
2.03	2°01.8′	123.627	41.208	82.419
2.04	2°02.4′	124.848	41.615	83.233
2.05	2°03.0′	126.075	42.024	84.051
2.06	2°03.6′	127.308	42.435	84.873
2.07	2°04.2′	128.547	42.848	85.699
2.08	2°04.8′	129.792	43.263	86.529
2.09	2°05.4′	131.043	43.680	87.363
2.10	2°06.0′	132.300	44.099	88.201
2.11	2°06.6′	133.563	44.520	89.043
2.12	2°07.2′	134.832	44.943	89.889
2.13	2°07.8′	136.107	45.368	90.739
2.14	2°08.4′	137.388	45.795	91.593
2.15	2°09.0′	138.675	46.224	92.451
2.16	2°09.6′	139.968	46.655	93.313
2.17	2°10.2′	141.267	47.088	94.179
2.18	2°10.8′	142.572	47.523	95.049
2.19	2°11.4′	143.883	47.960	95.923
2.20	2°12.0′	145.200	48.399	96.801
2.21	2°12.6′	146.523	48.840	97.683
2.22	2°13.2′	147.852	49.283	98.569
2.23	2°13.8′	149.187	49.728	99.459
2.24	2°14.4′	150.528	50.175	100.353
2.25	2°15.0′	151.875	50.624	101.251
2.26	2°15.6′	153.228	51.075	102.153
2.27	2°16.2′	154.587	51.528	103.059
2.28	2°16.8′	155.952	51.983	103.969
2.29	2°17.4′	157.323	52.440	104.883
2.30	2°18.0′	158.700	52.899	105.801
2.31	2°18.6′	160.083	53.360	106.723
2.32	2°19.2′	161.472	53.823	107.649
2.33	2°19.8′	162.867	54.288	108.579
2.34	2°20.4′	164.268	54.755	109.513
2.35	2°21.0′	165.675	55.224	110.451
2.36	2°21.6′	167.088	55.695	111.393
2.37	2°22.2′	168.507	56.168	112.339
2.38	2°22.8′	169.932	56.643	113.289
2.39	2°23.4′	171.363	57.120	114.243

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
2.40	2°24.0′	172.800	57.599	115.201
2.41	2°24.6′	174.243	58.080	116.163
2.42	2°25.2′	175.692	58.563	117.129
2.43	2°25.8′	177.147	59.047	118.100
2.44	2°26.4′	178.608	59.534	119.074
2.45	2°27.0′	180.075	60.023	120.052
2.46	2°27.6′	181.548	60.514	121.034
2.47	2°28.2′	183.027	61.007	122.020
2.48	2°28.8′	184.512	61.502	123.010
2.49	2°29.4′	186.003	61.999	124.004
2.50	2°30.0′	187.500	62.498	125.002
2.51	2°30.6′	189.003	62.999	126.004
2.52	2°31.2′	190.512	63.502	127.010
2.53	2°31.8′	192.027	64.007	128.020
2.54	2°32.4′	193.548	64.514	129.034
2.55	2°33.0′	195.075	65.023	130.052
2.56	2°33.6′	196.608	65.534	131.074
2.57	2°34.2′	198.147	66.047	132.100
2.58	2°34.8′	199.692	66.562	133.130
2.59	2°35.4′	201.243	67.079	134.164
2.60	2°36.0′	202.800	67.598	135.202
2.61	2°36.6′	204.363	68.119	136.244
2.62	2°37.2′	205.932	68.642	137.290
2.63	2°37.8′	207.507	69.167	138.340
2.64	2°38.4′	209.088	69.694	139.394
2.65	2°39.0′	210.675	70.222	140.453
2.66	2°39.6′	212.268	70.753	141.515
2.67	2°40.2′	213.867	71.286	142.581
2.68	2°40.8′	215.472	71.821	143.651
2.69	2°41.4′	217.083	72.358	144.725
2.70	2°42.0′	218.700	72.897	145.803
2.71	2°42.6′	220.323	73.438	146.885
2.72	2°43.2′	221.952	73.981	147.971
2.73	2°43.8′	223.587	74.526	149.061
2.74	2°44.4′	225.228	75.073	150.155
2.75	2°45.0′	226.875	75.622	151.253
2.76	2°45.6′	228.528	76.173	152.355
2.77	2°46.2′	230.187	76.726	153.461
2.78	2°46.8′	231.852	77.281	154.571
2.79	2°47.4′	233.523	77.838	155.685
2.80	2°48.0′	235.200	78.397	156.803
2.81	2°48.6′	236.883	78.957	157.926
2.82	2°49.2′	238.572	79.520	159.052
2.83	2°49.8′	240.267	80.085	160.182
2.84	2°50.4′	241.968	80.652	161.316
2.85	2°51.0′	243.675	81.221	162.454
2.86	2°51.6′	245.388	81.792	163.596
2.87	2°52.2′	247.107	82.365	164.742
2.88	2°52.8′	248.832	82.940	165.892
2.89	2°53.4′	250.563	83.517	167.046
2.90	2°54.0′	252.300	84.096	168.204
2.91	2°54.6′	254.043	84.677	169.366
2.92	2°55.2′	255.792	85.260	170.532
2.93	2°55.8′	257.547	85.844	171.703
2.94	2°56.4′	259.308	86.431	172.877
2.95	2°57.0′	261.075	87.020	174.055
2.96	2°57.6′	262.848	87.611	175.237
2.97	2°58.2	264.627	88.204	176.423
2.98	2°58.8′	266.412	88.799	177.613
2.99	2°59.4′	268.203	89.396	178.807

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
3.00	3°00.0′	270.000	89.995	180.005
3.01	3°00.6′	271.803	90.596	181.207
3.02	3°01.2′	273.612	91.199	182.413
3.03	3°01.8′	275.427	91.804	183.623
3.04	3°02.4′	277.248	92.411	184.837
3.05	3°03.0′	279.075	93.020	186.055
3.06	3°03.6′	280.908	93.631	187.277
3.07	3°04.2′	282.747	94.244	188.503
3.08	3°04.8′	284.592	94.858	189.734
3.09	3°05.4′	286.443	95.475	190.968
3.10	3°06.0′	288.300	96.094	192.206
3.11	3°06.6′	290.163	96.715	193.448
3.12	3°07.2′	292.032	97.338	194.694
3.13	3°07.8′	293.907	97.963	195.944
3.14	3°08.4′	295.788	98.590	197.198
3.15	3°09.0′	297.675	99.219	198.456
3.16	3°09.6′	299.568	99.850	199.718
3.17	3°10.2′	301.467	100.482	200.985
3.18	3°10.8′	303.372	101.117	202.255
3.19	3°11.4′	305.283	101.754	203.529
3.20	3°12.0′	307.200	102.393	204.807
3.21	3°12.6′	309.123	103.034	206.089
3.22	3°13.2′	311.052	103.677	207.375
3.23	3°13.8′	312.987	104.322	208.665
3.24	3°14.4′	314.928	104.968	209.960
3.25	3°15.0′	316.875	105.617	211.258
3.26	3°15.6′	318.828	106.268	212.560
3.27	3°16.2′	320.787	106.921	213.866
3.28	3°16.8′	322.752	107.576	215.176
3.29	3°17.4′	324.723	108.233	216.490
3.30	3°18.0′	326.700	108.892	217.808
3.31	3°18.6′	328.683	109.552	219.131
3.32	3°19.2′	330.672	110.215	220.457
3.33	3°19.8′	332.667	110.880	221.787
3.34	3°20.4′	334.668	111.547	223.121
3.35	3°21.0′	336.675	112.216	224.459
3.36	3°21.6′	338.688	112.887	225.801
3.37	3°22.2′	340.707	113.559	227.148
3.38	3°22.8′	342.732	114.234	228.498
3.39	3°23.4′	344.763	114.911	229.852
3.40	3°24.0′	346.800	115.590	231.210
3.41	3°24.6′	348.843	116.271	232.572
3.42	3°25.2′	350.892	116.954	233.938
3.43	3°25.8′	352.947	117.638	235.309
3.44	3°26.4′	355.008	118.325	236.683
3.45	3°27.0′	357.075	119.014	238.061
3.46	3°27.6′	359.148	119.705	239.443
3.47	3°28.2′	361.227	120.398	240.829
3.48	3°28.8′	363.312	121.092	242.220
3.49	3°29.4′	365.403	121.789	243.614
3.50	3°30.0′	367.500	122.488	245.012
3.51	3°30.6′	369.603	123.189	246.414
3.52	3°31.2′	371.712	123.892	247.820
3.53	3°31.8′	373.827	124.596	249.231
3.54	3°32.4′	375.948	125.303	250.645
3.55	3°33.0′	378.075	126.012	252.063
3.56	3°33.6′	380.208	126.723	253.485
3.57	3°34.2′	382.347	127.436	254.911
3.58	3°34.8′	384.492	128.150	256.342
3.59	3°35.4′	386.643	128.867	257.776

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
3.60	3°36.0′	388.800	129.586	259.214
3.61	3°36.6′	390.963	130.307	260.656
3.62	3°37.2′	393.132	131.029	262.103
3.63	3°37.8′	395.307	131.754	263.553
3.64	3°38.4′	397.488	132.481	265.007
3.65	3°39.0′	399.675	133.210	266.465
3.66	3°39.6′	401.868	133.940	267.928
3.67	3°40.2′	404.067	134.673	269.394
3.68	3°40.8′	406.272	135.408	270.864
3.69	3°41.4′	408.483	136.145	272.338
3.70	3°42.0′	410.700	136.883	273.817
3.71	3°42.6′	412.923	137.624	275.299
3.72	3°43.2′	415.152	138.367	276.785
3.73	3°43.8′	417.387	139.112	278.275
3.74	3°44.4′	419.628	139.858	279.770
3.75	3°45.0′	421.875	140.607	281.268
3.76	3°45.6′	424.128	141.358	282.770
3.77	3°46.2′	426.387	142.110	284.277
3.78	3°46.8′	428.652	142.865	285.787
3.79	3°47.4′	430.923	143.622	287.301
3.80	3°48.0′	433.200	144.380	288.820
3.81	3°48.6′	435.483	145.141	290.342
3.82	3°49.2′	437.772	145.904	291.868
3.83	3°49.8′	440.067	146.669	293.398
3.84	3°50.4′	442.368	147.435	294.933
3.85	3°51.0′	444.675	148.204	296.471
3.86	3°51.6′	446.988	148.975	298.013
3.87	3°52.2′	449.307	149.747	299.560
3.88	3°52.8′	451.632	150.522	301.110
3.89	3°53.4′	453.963	151.299	302.664
3.90	3°54.0′	456.300	152.077	304.223
3.91	3°54.6′	458.643	152.858	305.785
3.92	3°55.2′	460.992	153.640	307.352
3.93	3°55.8′	463.347	154.425	308.922
3.94	3°56.4′	465.708	155.212	310.496
3.95	3°57.0′	468.075	156.000	312.075
3.96	3°57.6′	470.448	156.791	313.657
3.97	3°58.2′	472.827	157.584	315.243
3.98	3°58.8′	475.212	158.378	316.834
3.99	3°59.4′	477.603	159.175	318.428
4.00	4°00.0′	480.000	159.973	320.027
4.01	4°00.6′	482.403	160.774	321.629
4.02	4°01.2′	484.812	161.577	323.235
4.03	4°01.8′	487.227	162.381	324.846
4.04	4°02.4′	489.648	163.188	326.460
4.05	4°03.0′	492.075	163.996	328.079
4.06	4°03.6′	494.508	164.807	329.701
4.07	4°04.2′	496.947	165.620	331.327
4.08	4°04.8′	499.392	166.434	332.958
4.09	4°05.4′	501.843	167.251	334.592
4.10	4°06.0′	504.300	168.069	336.231
4.11	4°06.6′	506.763	168.890	337.873
4.12	4°07.2′	509.232	169.712	339.520
4.13	4°07.8′	511.707	170.537	341.170
4.14	4°08.4′	514.188	171.363	342.825
4.15	4°09.0′	516.675	172.192	344.483
4.16	4°09.6′	519.168	173.022	346.146
4.17	4°10.2′	521.667	173.855	347.812
4.18	4°10.8′	524.172	174.689	349.483
4.19	4°11.4′	526.683	175.526	351.157

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
4.20	4°12.0′	529.200	176.364	352.836
4.21	4°12.6′	531.723	177.205	354.518
4.22	4°13.2′	534.252	178.047	356.205
4.23	4°13.8′	536.787	178.892	357.895
4.24	4°14.4′	539.328	179.738	359.590
4.25	4°15.0′	541.875	180.587	361.288
4.26	4°15.6′	544.428	181.437	362.991
4.27	4°16.2′	546.987	182.290	364.697
4.28	4°16.8′	549.552	183.144	366.408
4.29	4°17.4′	552.123	184.001	368.122
4.30	4°18.0′	554.700	184.859	369.841
4.31	4°18.6′	557.283	185.720	371.563
4.32	4°19.2′	559.872	186.582	373.290
4.33	4°19.8′	562.467	187.446	375.021
4.34	4°20.4′	565.068	188.313	376.755
4.35	4°21.0′	567.675	189.181	378.494
4.36	4°21.6′	570.288	190.052	380.236
4.37	4°22.2′	572.907	190.924	381.983
4.38	4°22.8′	575.532	191.798	383.734
4.39	4°23.4′	578.163	192.675	385.488
4.40	4°24.0′	580.800	193.553	387.247
4.41	4°24.6′	583.443	194.433	389.010
4.42	4°25.2′	586.092	195.316	390.776
4.43	4°25.8′	588.747	196.200	392.547
4.44	4°26.4′	591.408	197.086	394.322
4.45	4°27.0′	594.075	197.975	396.100
4.46	4°27.6′	596.748	198.865	397.883
4.47	4°28.2′	599.427	199.757	399.670
4.48	4°28.8′	602.112	200.652	401.460
4.49	4°29.4′	604.803	201.548	403.255
4.50	4°30.0′	607.500	202.446	405.054
4.51	4°30.6′	610.203	203.347	406.856
4.52	4°31.2′	612.912	204.249	408.663
4.53	4°31.8′	615.627	205.153	410.474
4.54	4°32.4′	618.348	206.059	412.289
4.55	4°33.0′	621.075	206.968	414.107
4.56	4°33.6′	623.808	207.878	415.930
4.57	4°34.2′	626.547	208.790	417.757
4.58	4°34.8′	629.292	209.704	419.588
4.59	4°35.4′	632.043	210.621	421.422
4.60	4°36.0′	634.800	211.539	423.261
4.61	4°36.6′	637.563	212.459	425.104
4.62	4°37.2′	640.332	213.381	426.951
4.63	4°37.8′	643.107	214.305	428.802
4.64	4°38.4′	645.888	215.231	430.657
4.65	4°39.0′	648.675	216.160	432.515
4.66	4°39.6′	651.468	217.090	434.378
4.67	4°40.2′	654.267	218.022	436.245
4.68	4°40.8′	657.072	218.956	438.116
4.69	4°41.4′	659.883	219.892	439.991
4.70	4°42.0′	662.700	220.830	441.870
4.71	4°42.6′	665.523	221.770	443.753
4.72	4°43.2′	668.352	222.713	445.639
4.73	4°43.8′	671.187	223.657	447.530
4.74	4°44.4′	674.028	224.603	449.425
4.75	4°45.0′	676.875	225.551	451.324
4.76	4°45.6′	679.728	226.501	453.227
4.77	4°46.2′	682.587	227.453	455.134
4.78	4°46.8′	685.452	228.407	457.045
4.79	4°47.4′	688.323	229.363	458.960

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
4.80	4°48.0′	691.200	230.321	460.879
4.81	4°48.6′	694.083	231.281	462.802
4.82	4°49.2′	696.972	232.243	464.729
4.83	4°49.8′	699.867	233.207	466.660
4.84	4°50.4′	702.768	234.173	468.595
4.85	4°51.0′	705.675	235.141	470.534
4.86	4°51.6′	708.588	236.111	472.477
4.87	4°52.2′	711.507	237.083	474.424
4.88	4°52.8′	714.432	238.057	476.375
4.89	4°53.4′	717.363	239.033	478.330
4.90	4°54.0′	720.300	240.011	480.289
4.91	4°54.6′	723.243	240.990	482.253
4.92	4°55.2′	726.192	241.972	484.220
4.93	4°55.8′	729.147	242.956	486.191
4.94	4°56.4′	732.108	243.942	488.166
4.95	4°57.0′	735.075	244.930	490.145
4.96	4°57.6′	738.048	245.920	492.128
4.97	4°58.2′	741.027	246.912	494.115
4.98	4°58.8′	744.012	247.905	496.107
4.99	4°59.4′	747.003	248.901	498.102
5.00	5°00.0′	750.000	249.899	500.101
5.01	5°00.6′	753.003	250.899	502.104
5.02	5°01.2′	756.012	251.901	504.111
5.03	5°01.8′	759.027	252.904	506.123
5.04	5°02.4′	762.048	253.910	508.138
5.05	5°03.0′	765.075	254.918	510.157
5.06	5°03.6′	768.108	255.928	512.180
5.07	5°04.2′	771.147	256.939	514.208
5.08	5°04.8′	774.192	257.953	516.239
5.09	5°05.4′	777.243	258.969	518.274
5.10	5°06.0′	780.300	259.986	520.314
5.11	5°06.6′	783.363	261.006	522.357
5.12	5°07.2′	786.432	262.028	524.404
5.13	5°07.8′	789.507	263.051	526.456
5.14	5°08.4′	792.588	264.077	528.511
5.15	5°09.0′	795.675	265.104	530.571
5.16	5°09.6′	798.768	266.134	532.634
5.17	5°10.2′	801.867	267.166	534.701
5.18	5°10.8′	804.972	268.199	536.773
5.19	5°11.4′	808.083	269.235	538.848
5.20	5°12.0′	811.200	270.272	540.928
5.21	5°12.6′	814.323	271.312	543.011
5.22	5°13.2′	817.452	272.353	545.099
5.23	5°13.8′	820.587	273.397	547.190
5.24	5°14.4′	823.728	274.442	549.286
5.25	5°15.0′	826.875	275.490	551.385
5.26	5°15.6′	830.028	276.539	553.489
5.27	5°16.2′	833.187	277.591	555.596
5.28	5°16.8′	836.352	278.644	557.708
5.29	5°17.4′	839.523	279.699	559.824
5.30	5°18.0′	842.700	280.757	561.943
5.31	5°18.6′	845.883	281.816	564.067
5.32	5°19.2′	849.072	282.877	566.195
5.33	5°19.8′	852.267	283.941	568.326
5.34	5°20.4′	855.468	285.006	570.462
5.35	5°21.0′	858.675	286.073	572.602
5.36	5°21.6′	861.888	287.143	574.745
5.37	5°22.2′	865.107	288.214	576.893
5.38	5°22.8′	868.332	289.287	579.045
5.39	5°23.4′	871.563	290.363	581.200

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
5.40	5°24.0′	874.800	291.440	583.360
5.41	5°24.6′	878.043	292.519	585.524
5.42	5°25.2′	881.292	293.600	587.692
5.43	5°25.8′	884.547	294.683	589.864
5.44	5°26.4′	887.808	295.768	592.040
5.45	5°27.0′	891.075	296.856	594.219
5.46	5°27.6′	894.348	297.945	596.403
5.47	5°28.2′	897.627	299.036	598.591
5.48	5°28.8′	900.912	300.129	600.783
5.49	5°29.4′	904.203	301.224	602.979
5.50	5°30.0′	907.500	302.321	605.179
5.51	5°30.6′	910.803	303.420	607.383
5.52	5°31.2′	914.112	304.521	609.591
5.53	5°31.8′	917.427	305.624	611.803
5.54	5°32.4′	920.748	306.729	614.019
5.55	5°33.0′	924.075	307.836	616.239
5.56	5°33.6′	927.408	308.945	618.463
5.57	5°34.2′	930.747	310.056	620.691
5.58	5°34.8′	934.092	311.169	622.923
5.59	5°35.4′	937.443	312.284	625.159
5.60	5°36.0′	940.800	313.401	627.399
5.61	5°36.6′	944.163	314.520	629.643
5.62	5°37.2′	947.532	315.640	631.892
5.63	5°37.8′	950.907	316.763	634.144
5.64	5°38.4′	954.288	317.888	636.400
5.65	5°39.0′	957.675	319.015	638.660
5.66	5°39.6′	961.068	320.143	640.925
5.67	5°40.2′	694.467	321.274	643.193
5.68	5°40.8′	967.872	322.407	645.465
5.69	5°41.4′	971.283	323.542	647.741
5.70	5°42.0′	974.700	324.678	650.022
5.71	5°42.6′	978.123	325.817	652.306
5.72	5°43.2′	981.552	326.958	654.594
5.73	5°43.8′	984.987	328.100	656.887
5.74	5°44.4′	988.428	329.245	659.183
5.75	5°45.0′	991.875	330.391	661.484
5.76	5°45.6′	995.328	331.540	663.788
5.77	5°46.2′	998.787	332.690	666.096
5.78	5°46.8′	1002.252	333.843	668.409
5.79	5°47.4′	1005.723	334.997	670.726
5.80	5°48.0′	1009.200	336.154	673.046
5.81	5°48.6′	1012.683	337.312	675.371
5.82	5°49.2′	1016.172	338.473	677.699
5.83	5°49.8′	1019.667	339.635	680.032
5.84	5°50.4′	1023.168	340.800	682.368
5.85	5°51.0′	1026.675	341.966	684.709
5.86	5°51.6′	1030.188	343.134	687.054
5.87	5°52.2′	1033.707	344.305	689.402
5.88	5°52.8′	1037.232	345.477	691.755
5.89	5°53.4′	1040.763	346.651	694.112
5.90	5°54.0′	1044.300	347.827	696.473
5.91	5°54.6′	1047.843	349.005	698.838
5.92	5°55.2′	1051.392	350.186	701.206
5.93	5°55.8′	1054.947	351.368	703.579
5.94	5°56.4′	1058.508	352.552	705.956
5.95	5°57.0′	1062.075	353.738	708.337
5.96	5°57.6′	1065.648	354.926	710.722
5.97	5°58.2′	1069.227	356.116	713.111
5.98	5°58.8′	1072.812	357.308	715.504
5.99	5°59.4′	1076.403	358.502	717.901

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
6.00	6°00.0′	1080.000	359.698	720.302
6.01	6°00.6′	1083.603	360.896	722.707
6.02	6°01.2′	1087.212	362.096	725.116
6.03	6°01.8′	1090.827	363.298	727.529
6.04	6°02.4′	1094.448	364.502	729.946
6.05	6°03.0′	1098.075	365.708	732.367
6.06	6°03.6′	1101.708	366.916	734.792
6.07	6°04.2′	1105.347	368.125	737.222
6.08	6°04.8′	1108.992	369.337	739.655
6.09	6°05.4′	1112.643	370.551	742.092
6.10	6°06.0′	1116.300	371.767	744.533
6.11	6°06.6′	1119.963	372.984	746.978
6.12	6°07.2′	1123.632	374.204	749.428
6.13	6°07.8′	1127.307	375.426	751.881
6.14	6°08.4′	1130.988	376.649	754.339
6.15	6°09.0′	1134.675	377.875	756.800
6.16	6°09.6′	1138.368	379.103	759.265
6.17	6°10.2′	1142.067	380.332	761.735
6.18	6°10.8′	1145.772	381.564	764.208
6.19	6°11.4′	1149.483	382.797	766.686
6.20	6°12.0′	1153.200	384.033	769.167
6.21	6°12.6′	1156.923	385.270	771.653
6.22	6°13.2′	1160.652	386.509	774.143
6.23	6°13.8′	1164.387	387.751	776.636
6.24	6°14.4′	1168.128	388.994	779.134
6.25	6°15.0′	1171.875	390.239	781.636
6.26	6°15.6′	1175.628	391.487	784.141
6.27	6°16.2′	1179.387	392.736	786.651
6.28	6°16.8′	1183.152	393.987	789.165
6.29	6°17.4′	1186.923	395.240	791.683
6.30	6°18.0′	1190.700	396.496	794.204
6.31	6°18.6′	1194.483	397.753	796.730
6.32	6°19.2′	1198.272	399.012	799.260
6.33	6°19.8′	1202.067	400.273	801.794
6.34	6°20.4′	1205.868	401.536	804.332
6.35	6°21.0′	1209.675	402.801	806.874
6.36	6°21.6′	1213.488	404.068	809.420
6.37	6°22.2′	1217.307	405.337	811.970
6.38	6°22.8′	1221.132	406.608	814.524
6.39	6°23.4′	1224.963	407.881	817.082
6.40	6°24.0′	1228.800	409.155	819.645
6.41	6°24.6′	1232.643	410.432	822.211
6.42	6°25.2′	1236.492	411.711	824.781
6.43	6°25.8′	1240.347	412.992	827.355
6.44	6°26.4′	1244.208	414.274	829.934
6.45	6°27.0′	1248.075	415.559	832.516
6.46	6°27.6′	1251.948	416.846	835.102
6.47	6°28.2′	1255.827	418.134	837.693
6.48	6°28.8′	1259.712	419.425	840.287
6.49	6°29.4′	1263.603	420.717	842.886
6.50	6°30.0′	1267.500	422.012	845.488
6.51	6°30.6′	1271.403	423.308	848.095
6.52	6°31.2′	1275.312	424.607	850.705
6.53	6°31.8′	1279.227	425.907	853.320
6.54	6°32.4′	1283.148	427.210	855.938
6.55	6°33.0′	1287.075	428.514	858.561
6.56	6°33.6′	1291.008	429.820	861.188
6.57	6°34.2′	1294.947	431.129	863.818
6.58	6°34.8′	1298.892	432.439	866.453
6.59	6°35.4′	1302.843	433.751	869.092

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
6.60	6°36.0′	1306.800	435.065	871.735
6.61	6°36.6′	1310.763	436.381	874.382
6.62	6°37.2′	1314.732	437.699	877.033
6.63	6°37.8′	1318.707	439.019	879.688
6.64	6°38.4′	1322.688	440.341	882.347
6.65	6°39.0′	1326.675	441.665	885.010
6.66	6°39.6′	1330.668	442.991	887.677
6.67	6°40.2′	1334.667	444.319	890.348
6.68	6°40.8′	1338.672	445.649	893.023
6.69	6°41.4′	1342.683	446.981	895.702
6.70	6°42.0′	1346.700	448.314	898.385
6.71	6°42.6′	1350.723	449.650	901.073
6.72	6°43.2′	1354.752	450.988	903.764
6.73	6°43.8′	1358.787	452.328	906.459
6.74	6°44.4′	1362.828	453.669	909.159
6.75	6°45.0′	1366.875	455.013	911.862
6.76	6°45.6′	1370.928	456.358	914.570
6.77	6°46.2′	1374.987	457.706	917.281
6.78	6°46.8′	1379.052	459.055	919.997
6.79	6°47.4′	1383.123	460.407	922.716
6.80	6°48.0′	1387.200	461.760	925.440
6.81	6°48.6′	1391.283	463.115	928.168
6.82	6°49.2′	1395.372	464.473	930.899
6.83	6°49.8′	1399.467	465.832	933.635
6.84	6°50.4′	1403.568	467.193	936.375
6.85	6°51.0′	1407.675	468.556	939.119
6.86	6°51.6′	1411.788	469.921	941.867
6.87	6°52.2′	1415.907	471.288	944.619
6.88	6°52.8′	1420.032	472.657	947.375
6.89	6°53.4′	1424.163	474.028	950.135
6.90	6°54.0′	1428.300	475.401	952.899
6.91	6°54.6′	1432.443	476.776	955.667
6.92	6°55.2′	1436.592	478.153	958.439
6.93	6°55.8′	1440.747	479.532	961.215
6.94	6°56.4′	1444.908	480.912	963.996
6.95	6°57.0′	1449.075	482.295	966.780
6.96	6°57.6′	1453.248	483.680	969.568
6.97	6°58.2′	1457.427	485.066	972.361
6.98	6°58.8′	1461.612	486.455	975.157
6.99	6°59.4′	1465.803	487.845	977.957
7.00	7°00.0′	1470.000	489.238	980.762
7.01	7°00.6′	1474.203	490.632	983.571
7.02	7°01.2′	1478.412	492.029	986.383
7.03	7°01.8′	1482.627	493.427	989.200
7.04	7°02.4′	1486.848	494.827	992.021
7.05	7°03.0′	1491.075	496.230	994.845
7.06	7°03.6′	1495.308	497.634	997.674
7.07	7°04.2′	1499.547	499.040	1000.507
7.08	7°04.8′	1503.792	500.448	1003.344
7.09	7°05.4′	1508.043	501.858	1006.185
7.10	7°06.0′	1512.300	503.270	1009.030
7.11	7°06.6′	1516.563	504.684	1011.879
7.12	7°07.2′	1520.832	506.100	1014.732
7.13	7°07.8′	1525.107	507.518	1017.589
7.14	7°08.4′	1529.388	508.938	1020.450
7.15	7°09.0′	1533.675	510.359	1023.316
7.16	7°09.6′	1537.968	511.783	1026.185
7.17	7°10.2′	1542.267	513.209	1029.058
7.18	7°10.8′	1546.572	514.636	1031.936
7.19	7°11.4′	1550.883	516.066	1034.817

UNIT TABLE

a = 1.0

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
7.20	7°12.0′	1555.200	517.497	1037.703
7.21	7°12.6′	1559.523	518.931	1040.592
7.22	7°13.2′	1563.852	520.366	1043.486
7.23	7°13.8′	1568.187	521.803	1046.384
7.24	7°14.4′	1572.528	523.243	1049.285
7.25	7°15.0′	1576.875	524.684	1052.191
7.26	7°15.6′	1581.228	526.127	1055.101
7.27	7°16.2′	1585.587	527.572	1058.015
7.28	7°16.8′	1589.952	529.019	1060.933
7.29	7°17.4′	1594.323	530.468	1063.855
7.30	7°18.0′	1598.700	531.919	1066.781
7.31	7°18.6′	1603.083	533.372	1069.711
7.32	7°19.2′	1607.472	534.827	1072.645
7.33	7°19.8′	1611.867	536.284	1075.583
7.34	7°20.4′	1616.268	537.742	1078.526
7.35	7°21.0′	1620.675	539.203	1081.472
7.36	7°21.6′	1625.088	540.666	1084.422
7.37	7°22.2′	1629.507	542.130	1087.377
7.38	7°22.8′	1633.932	543.596	1090.335
7.39	7°23.4′	1638.363	545.065	1093.298
7.40	7°24.0′	1642.800	546.535	1096.265
7.41	7°24.6′	1647.243	548.008	1099.235
7.42	7°25.2′	1651.692	549.482	1102.210
7.43	7°25.8′	1656.147	550.958	1105.189
7.44	7°26.4′	1660.608	552.436	1108.172
7.45	7°27.0′	1665.075	553.916	1111.159
7.46	7°27.6′	1669.548	555.398	1114.150
7.47	7°28.2′	1674.027	556.882	1117.145
7.48	7°28.8′	1678.512	558.368	1120.144
7.49	7°29.4′	1683.003	559.856	1123.147
7.50	7°30.0′	1687.500	561.346	1126.154
7.51	7°30.6′	1692.003	562.837	1129.166
7.52	7°31.2′	1696.512	564.331	1132.181
7.53	7°31.8′	1701.027	565.827	1135.200
7.54	7°32.4′	1705.548	567.324	1138.224
7.55	7°33.0′	1710.075	568.824	1141.251
7.56	7°33.6′	1714.608	570.325	1144.283
7.57	7°34.2′	1719.147	571.828	1147.319
7.58	7°34.8′	1723.692	573.334	1150.358
7.59	7°35.4′	1728.243	574.841	1153.402
7.60	7°36.0′	1732.800	576.350	1156.450
7.61	7°36.6′	1737.363	577.861	1159.502
7.62	7°37.2′	1741.932	579.374	1162.558
7.63	7°37.8′	1746.507	580.889	1165.618
7.64	7°38.4′	1751.088	582.406	1168.682
7.65	7°39.0′	1755.675	583.924	1171.751
7.66	7°39.6′	1760.268	585.445	1174.823
7.67	7°40.2′	1764.867	586.968	1177.899
7.68	7°40.8′	1769.472	588.492	1180.979
7.69	7°41.4′	1774.083	590.019	1184.064
7.70	7°42.0′	1778.700	591.547	1187.153
7.71	7°42.6′	1783.323	593.078	1190.245
7.72	7°43.2′	1787.952	594.610	1193.342
7.73	7°43.8′	1792.587	596.144	1196.443
7.74	7°44.4′	1797.228	597.681	1199.547
7.75	7°45.0′	1801.875	599.219	1202.656
7.76	7°45.6′	1806.528	600.759	1205.769
7.77	7°46.2′	1811.187	602.301	1208.886
7.78	7°46.8′	1815.852	603.845	1212.008
7.79	7°47.4′	1820.523	605.390	1215.133

UNIT TABLE

$a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
7.80	7°48.0′	1825.200	606.938	1218.262
7.81	7°48.6′	1829.883	608.488	1221.395
7.82	7°49.2′	1834.572	610.039	1224.533
7.83	7°49.8′	1839.267	611.593	1227.674
7.84	7°50.4′	1843.968	613.148	1230.820
7.85	7°51.0′	1848.675	614.706	1233.969
7.86	7°51.6′	1853.388	616.265	1237.123
7.87	7°52.2′	1858.107	617.826	1240.281
7.88	7°52.8′	1862.832	619.389	1243.443
7.89	7°53.4′	1867.563	620.954	1246.609
7.90	7°54.0′	1872.300	622.521	1249.779
7.91	7°54.6′	1877.043	624.090	1252.953
7.92	7°55.2′	1881.792	625.661	1256.131
7.93	7°55.8′	1886.547	627.234	1259.313
7.94	7°56.4′	1891.308	628.809	1262.499
7.95	7°57.0′	1896.075	630.385	1265.690
7.96	7°57.6′	1900.848	631.964	1268.884
7.97	7°58.2′	1905.627	633.544	1272.083
7.98	7°58.8′	1910.412	635.127	1275.285
7.99	7°59.4′	1915.203	636.711	1278.492
8.00	8°00.0′	1920.000	638.297	1281.703
8.01	8°00.6′	1924.803	639.885	1284.918
8.02	8°01.2′	1929.612	641.475	1288.137
8.03	8°01.8′	1934.427	643.067	1291.360
8.04	8°02.4′	1939.248	644.661	1294.587
8.05	8°03.0′	1944.075	646.257	1297.818
8.06	8°03.6′	1948.908	647.855	1301.053
8.07	8°04.2′	1953.747	649.454	1304.293
8.08	8°04.8′	1958.592	651.056	1307.536
8.09	8°05.4′	1963.443	652.659	1310.784
8.10	8°06.0′	1968.300	654.265	1314.035
8.11	8°06.6′	1973.163	655.872	1317.291
8.12	8°07.2′	1978.032	657.481	1320.551
8.13	8°07.8′	1982.907	659.092	1323.815
8.14	8°08.4′	1987.788	660.705	1327.083
8.15	8°09.0′	1992.675	662.320	1330.355
8.16	8°09.6′	1997.568	663.937	1333.631
8.17	8°10.2′	2002.467	665.556	1336.911
8.18	8°10.8′	2007.372	667.176	1340.196
8.19	8°11.4′	2012.283	668.799	1343.484
8.20	8°12.0′	2017.200	670.424	1346.777
8.21	8°12.6′	2022.123	672.050	1350.073
8.22	8°13.2′	2027.052	673.678	1353.374
8.23	8°13.8′	2031.987	675.308	1356.679
8.24	8°14.4′	2036.928	676.941	1359.987
8.25	8°15.0′	2041.875	678.575	1363.300
8.26	8°15.6′	2046.828	680.211	1366.617
8.27	8°16.2′	2051.787	681.849	1369.938
8.28	8°16.8′	2056.752	683.488	1373.264
8.29	8°17.4′	2061.723	685.130	1376.593
8.30	8°18.0′	2066.700	686.774	1379.926
8.31	8°18.6′	2071.683	688.419	1383.264
8.32	8°19.2′	2076.672	690.066	1386.606
8.33	8°19.8′	2081.667	691.716	1389.951
8.34	8°20.4′	2086.668	693.367	1393.301
8.35	8°21.0′	2091.675	695.020	1396.655
8.36	8°21.6′	2096.688	696.675	1400.013
8.37	8°22.2′	2101.707	698.332	1403.375
8.38	8°22.8′	2106.732	699.991	1406.741
8.39	8°23.4′	2111.763	701.652	1410.111

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
8.40	8°24.0′	2116.800	703.314	1413.486
8.41	8°24.6′	2121.843	704.979	1416.864
8.42	8°25.2′	2126.892	706.645	1420.247
8.43	8°25.8′	2131.947	708.313	1423.634
8.44	8°26.4′	2137.008	709.984	1427.024
8.45	8°27.0′	2142.075	711.656	1430.419
8.46	8°27.6′	2147.148	713.330	1433.818
8.47	8°28.2′	2152.227	715.006	1437.221
8.48	8°28.8′	2157.312	716.684	1440.629
8.49	8°29.4′	2162.403	718.363	1444.040
8.50	8°30.0′	2167.500	720.045	1447.455
8.51	8°30.6′	2172.603	721.728	1450.875
8.52	8°31.2′	2177.712	723.414	1454.298
8.53	8°31.8′	2182.827	725.101	1457.726
8.54	8°32.4′	2187.948	726.790	1461.158
8.55	8°33.0′	2193.075	728.481	1464.594
8.56	8°33.6′	2198.208	730.174	1468.034
8.57	8°34.2′	2203.347	731.869	1471.478
8.58	8°34.8′	2208.492	733.566	1474.926
8.59	8°35.4′	2213.643	735.265	1478.378
8.60	8°36.0′	2218.800	736.965	1481.835
8.61	8°36.6′	2223.963	738.668	1485.295
8.62	8°37.2′	2229.132	740.372	1488.760
8.63	8°37.8′	2234.307	742.078	1492.229
8.64	8°38.4′	2239.488	743.786	1495.702
8.65	8°39.0′	2244.675	745.496	1499.179
8.66	8°39.6′	2249.868	747.208	1502.660
8.67	8°40.2′	2255.067	748.922	1506.145
8.68	8°40.8′	2260.272	750.638	1509.634
8.69	8°41.4′	2265.483	752.355	1513.128
8.70	8°42.0′	2270.700	754.075	1516.625
8.71	8°42.6′	2275.923	755.796	1520.127
8.72	8°43.2′	2281.152	757.519	1523.633
8.73	8°43.8′	2286.387	759.244	1527.143
8.74	8°44.4′	2291.628	760.971	1530.657
8.75	8°45.0′	2296.875	762.700	1534.175
8.76	8°45.6′	2302.128	764.431	1537.697
8.77	8°46.2′	2307.387	766.163	1541.224
8.78	8°46.8′	2312.652	767.898	1544.754
8.79	8°47.4′	2317.923	769.634	1548.289
8.80	8°48.0′	2323.200	771.372	1551.828
8.81	8°48.6′	2328.483	773.113	1555.370
8.82	8°49.2′	2333.772	774.855	1558.917
8.83	8°49.8′	2339.067	776.599	1562.468
8.84	8°50.4′	2344.368	778.344	1566.024
8.85	8°51.0′	2349.675	780.092	1569.583
8.86	8°51.6′	2354.988	781.842	1573.146
8.87	8°52.2′	2360.307	783.593	1576.714
8.88	8°52.8′	2365.632	785.346	1580.286
8.89	8°53.4′	2370.963	787.101	1583.862
8.90	8°54.0′	2376.300	788.858	1587.442
8.91	8°54.6′	2381.643	790.617	1591.026
8.92	8°55.2′	2386.992	792.378	1594.614
8.93	8°55.8′	2392.347	794.141	1598.206
8.94	8°56.4′	2397.708	795.905	1601.803
8.95	8°57.0′	2403.075	797.672	1605.403
8.96	8°57.6′	2408.448	799.440	1609.008
8.97	8°58.2′	2413.827	801.210	1612.617
8.98	8°58.8′	2419.212	802.982	1616.230
8.99	8°59.4′	2424.603	804.756	1619.847

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
9.00	9°00.0′	2430.000	806.532	1623.468
9.01	9°00.6′	2435.403	808.309	1627.094
9.02	9°01.2′	2440.812	810.089	1630.723
9.03	9°01.8′	2446.227	811.870	1634.357
9.04	9°02.4′	2451.648	813.654	1637.994
9.05	9°03.0′	2457.075	815.439	1641.636
9.06	9°03.6′	2462.508	817.226	1645.282
9.07	9°04.2′	2467.947	819.014	1648.933
9.08	9°04.8′	2473.392	820.805	1652.587
9.09	9°05.4′	2478.843	822.598	1656.245
9.10	9°06.0′	2484.300	824.392	1659.908
9.11	9°06.6′	2489.763	826.188	1663.575
9.12	9°07.2′	2495.232	827.987	1667.246
9.13	9°07.8′	2500.707	829.787	1670.921
9.14	9°08.4′	2506.188	831.588	1674.600
9.15	9°09.0′	2511.675	833.392	1678.283
9.16	9°09.6′	2517.168	835.198	1681.970
9.17	9°10.2′	2522.667	837.005	1685.662
9.18	9°10.8′	2528.172	838.814	1689.358
9.19	9°11.4′	2533.683	840.626	1693.058
9.20	9°12.0′	2539.200	842.438	1696.762
9.21	9°12.6′	2544.723	844.253	1700.470
9.22	9°13.2′	2550.252	846.070	1704.182
9.23	9°13.8′	2555.787	847.889	1707.898
9.24	9°14.4′	2561.328	849.709	1711.619
9.25	9°15.0′	2566.875	851.531	1715.344
9.26	9°15.6′	2572.428	853.356	1719.072
9.27	9°16.2′	2577.987	855.182	1722.806
9.28	9°16.8′	2583.552	857.009	1726.543
9.29	9°17.4′	2589.123	858.839	1730.284
9.30	9°18.0′	2594.700	860.671	1734.029
9.31	9°18.6′	2600.283	862.504	1737.779
9.32	9°19.2′	2605.872	864.339	1741.533
9.33	9°19.8′	2611.467	866.176	1745.291
9.34	9°20.4′	2617.068	868.015	1749.053
9.35	9°21.0′	2622.675	869.856	1752.819
9.36	9°21.6′	2628.288	871.699	1756.589
9.37	9°22.2′	2633.907	873.543	1760.364
9.38	9°22.8′	2639.532	875.389	1764.143
9.39	9°23.4′	2645.163	877.238	1767.926
9.40	9°24.0′	2650.800	879.088	1771.712
9.41	9°24.6′	2656.443	880.939	1775.504
9.42	9°25.2′	2662.092	882.793	1779.299
9.43	9°25.8′	2667.747	884.648	1783.099
9.44	9°26.4′	2673.408	886.506	1786.902
9.45	9°27.0′	2679.075	888.365	1790.710
9.46	9°27.6′	2684.748	890.226	1794.522
9.47	9°28.2′	2690.427	892.089	1798.338
9.48	9°28.8′	2696.112	893.954	1802.158
9.49	9°29.4′	2701.803	895.820	1805.983
9.50	9°30.0′	2707.500	897.689	1809.811
9.51	9°30.6′	2713.203	899.559	1813.644
9.52	9°31.2′	2718.912	901.431	1817.481
9.53	9°31.8′	2724.627	903.305	1821.322
9.54	9°32.4′	2730.348	905.181	1825.167
9.55	9°33.0′	2736.075	907.058	1829.017
9.56	9°33.6′	2741.808	908.937	1832.871
9.57	9°34.2′	2747.547	910.819	1836.728
9.58	9°34.8′	2753.292	912.702	1840.590
9.59	9°35.4′	2759.043	914.587	1844.456

UNIT TABLE $a = 1.0$

Length in Stations	D in Degrees and Minutes	S in Minutes	i in Minutes	I in Minutes
9.60	9°36.0′	2764.800	916.473	1848.327
9.61	9°36.6′	2770.563	918.362	1852.201
9.62	9°37.2′	2776.332	920.252	1856.080
9.63	9°37.8′	2782.107	922.144	1859.963
9.64	9°38.4′	2787.888	924.038	1863.850
9.65	9°39.0′	2793.675	925.934	1867.741
9.66	9°39.6′	2799.468	927.832	1871.636
9.67	9°40.2′	2805.267	929.731	1875.536
9.68	9°40.8′	2811.072	931.633	1879.439
9.69	9°41.4′	2816.883	933.536	1883.347
9.70	9°42.0′	2822.700	935.441	1887.259
9.71	9°42.6′	2828.523	937.347	1891.176
9.72	9°43.2′	2834.352	939.256	1895.096
9.73	9°43.8′	2840.187	941.167	1899.020
9.74	9°44.4′	2846.028	943.079	1902.949
9.75	9°45.0′	2851.875	944.993	1906.882
9.76	9°45.6′	2857.728	946.909	1910.819
9.77	9°46.2′	2863.587	948.826	1914.761
9.78	9°46.8′	2369.452	950.746	1918.706
9.79	9°47.4′	2875.323	952.667	1922.656
9.80	9°48.0′	2881.200	954.590	1926.610
9.81	9°48.6′	2887.083	956.515	1930.568
9.82	9°49.2′	2892.972	958.442	1934.530
9.83	9°49.8′	2898.867	960.370	1938.497
9.84	9°50.4′	2904.768	962.301	1942.467
9.85	9°51.0′	2910.675	964.233	1946.442
9.86	9°51.6′	2916.588	966.167	1950.421
9.87	9°52.2′	2922.507	968.103	1954.404
9.88	9°52.8′	2928.432	970.040	1958.392
9.89	9°53.4′	2934.363	971.980	1962.383
9.90	9°54.0′	2940.300	973.921	1966.379
9.91	9°54.6′	2946.243	975.864	1970.379
9.92	9°55.2′	2952.192	977.809	1974.383
9.93	9°55.8′	2958.147	979.755	1978.392
9.94	9°56.4′	2964.108	981.704	1982.404
9.95	9°57.0′	2970.075	983.654	1986.421
9.96	9°57.6′	2976.048	985.606	1990.442
9.97	9°58.2′	2982.027	987.560	1994.467
9.98	9°58.8′	2988.012	989.515	1998.497
9.99	9°59.4′	2994.003	991.473	2002.530
10.00	10°00.0′	3000.000	993.432	2006.568

TABLE III

Deflection from intermediate chord points on spirals to other chord points at 10′ intervals.

Giving deflections in minutes, for

$$\text{“a”} = \left(\frac{D}{L}\right) = 1,$$

from intermediate chord points to any other chord point at 10 foot intervals. Multiply tabular values by the actual value of “a” to obtain true values for the particular problem.

Interpolations may be made for any distance falling between points given in table.

Example: To obtain deflections for any series of points when transit is set at a point say 190 feet from the P. S.

In the table under the heading 190 follow down vertically to space marked 00. The figures on the horizontal line forward or back give deflection angles in minutes to the several points indicated at the top of the several columns.

Rule: Always work on the horizontal lines. Deflections are given either forward to the right or backward to the left from any point shown in the diagonal squares to the other points listed.

DEFLECTION TABLE

$a = 1$

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
	P. S.	0.1	0.4	0.9	1.6	2.5	3.6	4.9	6.4	8.1	10.0	12.1	14.4	16.9	19.6	22.5	25.6	28.9	32.4	36.1	40.0
10	0.2	0.0	0.4	1.0	1.8	2.8	4.0	5.4	7.0	8.8	10.8	13.0	15.4	18.0	20.8	23.8	27.0	30.4	34.0	37.8	41.8
20	0.8	0.5	0.0	0.7	1.6	2.7	4.0	5.5	7.2	9.1	11.2	13.5	16.0	18.7	21.6	24.7	28.0	31.5	35.2	39.1	43.2
30	1.8	1.4	0.8	0.0	1.0	2.2	3.6	5.2	7.0	9.0	11.2	13.6	16.2	19.0	22.0	25.2	28.6	32.2	36.0	40.0	44.2
40	3.2	2.7	2.0	1.1	0.0	1.3	2.8	4.5	6.4	8.5	10.8	13.3	16.0	18.9	22.0	25.3	28.8	32.5	36.4	40.5	44.8
50	5.0	4.4	3.6	2.6	1.4	0.0	1.6	3.4	5.4	7.6	10.0	12.6	15.4	18.4	21.6	25.0	28.6	32.4	36.4	40.6	45.0
60	7.2	6.5	5.6	4.5	3.2	1.7	0.0	1.9	4.0	6.3	8.8	11.5	14.4	17.5	20.8	24.3	28.0	31.9	36.0	40.3	44.8
70	9.8	9.0	8.0	6.8	5.4	3.8	2.0	0.0	2.2	4.6	7.2	10.0	13.0	16.2	19.6	23.2	27.0	31.0	35.2	39.6	44.2
80	12.8	11.9	10.8	9.5	8.0	6.3	4.4	2.3	0.0	2.5	5.2	8.1	11.2	14.5	18.0	21.7	25.6	29.7	34.0	38.5	43.2
90	16.2	15.2	14.0	12.6	11.0	9.2	7.2	5.0	2.6	0.0	2.8	5.8	9.0	12.4	16.0	19.8	23.8	28.0	32.4	37.0	41.8
100	20.0	18.9	17.6	16.1	14.4	12.5	10.4	8.1	5.6	2.9	0.0	3.1	6.4	9.9	13.6	17.5	21.6	25.9	30.4	35.1	40.0
110	24.2	23.0	21.6	20.0	18.2	16.2	14.0	11.6	9.0	6.2	3.2	0.0	3.4	7.0	10.8	14.8	19.0	23.4	28.0	32.8	37.8
120	28.8	27.5	26.0	24.3	22.4	20.3	18.0	15.5	12.8	9.9	6.8	3.5	0.0	3.7	7.6	11.7	16.0	20.5	25.2	30.1	35.2
130	33.8	32.4	30.8	29.0	27.0	24.8	22.4	19.8	17.0	14.0	10.8	7.4	3.8	0.0	4.0	8.2	12.6	17.2	22.0	27.0	32.2
140	39.2	37.7	36.0	34.1	32.0	29.7	27.2	24.5	21.6	18.5	15.2	11.7	8.0	4.1	0.0	4.3	8.8	13.5	18.4	23.5	28.8
150	45.0	43.4	41.6	39.6	37.4	35.0	32.4	29.6	26.6	23.4	20.0	16.4	12.6	8.6	4.4	0.0	4.6	9.4	14.4	19.6	25.0
160	51.2	49.5	47.6	45.5	43.2	40.7	38.0	35.1	32.0	28.7	25.2	21.5	17.6	13.5	9.2	4.7	0.0	4.9	10.0	15.3	20.8
170	57.8	56.0	54.0	51.8	49.4	46.8	44.0	41.0	37.8	34.4	30.8	27.0	23.0	18.8	14.4	9.8	5.0	0.0	5.2	10.6	16.2
180	64.8	62.9	60.8	58.5	56.0	53.3	50.4	47.3	44.0	40.5	36.8	32.9	28.8	24.5	20.0	15.3	10.4	5.3	0.0	5.5	11.2
190	72.2	70.2	68.0	65.6	63.0	60.2	57.2	54.0	50.6	47.0	43.2	39.2	35.0	30.6	26.0	21.2	16.2	11.0	5.6	0.0	5.8
200	80.0	77.9	75.6	73.1	70.4	67.5	64.4	61.1	57.6	53.9	50.0	45.9	41.6	37.1	32.4	27.5	22.4	17.1	11.6	5.9	0.0

DEFLECTION TABLE

$a = 1$

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
0	40.0	44.1	48.4	52.9	57.6	62.5	67.6	72.9	78.4	84.1	90.0	96.1	102.4	108.9	115.6	122.5	129.6	136.9	144.4	152.1	160.0
10	41.8	46.0	50.4	55.0	59.8	64.8	70.0	75.4	81.0	86.8	92.8	99.0	105.4	112.0	118.8	125.8	133.0	140.4	148.0	155.8	163.8
20	43.2	47.5	52.0	56.7	61.6	66.7	72.0	77.5	8.32	89.1	95.2	101.5	108.0	114.7	121.6	128.7	136.0	143.5	151.2	159.1	167.2
30	44.2	48.6	53.2	58.0	63.0	68.2	73.6	79.2	85.0	91.0	97.2	103.6	110.2	117.0	124.0	131.2	138.6	146.2	154.0	162.0	170.2
40	44.8	49.3	54.0	58.9	64.0	69.3	74.8	80.5	86.4	92.5	98.8	105.3	112.0	118.9	126.0	133.3	140.8	148.5	156.4	164.5	172.8
50	45.0	49.6	54.4	59.4	64.6	70.0	75.6	81.4	87.4	93.6	100.0	106.6	113.4	120.4	127.6	135.0	142.6	150.4	158.4	166.6	175.0
60	44.8	49.5	54.4	59.5	64.8	70.3	76.0	81.9	88.0	94.3	100.8	107.5	114.4	121.5	128.8	136.3	144.0	151.9	160.0	168.3	176.8
70	44.2	49.0	54.0	59.2	64.6	70.2	76.0	82.0	88.2	94.6	101.2	108.0	115.0	122.2	129.6	137.2	145.0	153.0	161.2	169.6	178.2
80	43.2	48.1	53.2	58.5	64.0	69.7	75.6	81.7	88.0	94.5	101.2	108.1	115.2	122.5	130.0	137.7	145.6	153.7	162.0	170.5	179.2
90	41.8	46.8	52.0	57.4	63.0	68.8	74.8	81.0	87.4	94.0	100.8	107.8	115.0	122.4	130.0	137.8	145.8	154.0	162.4	171.0	179.8
100	40.0	45.1	50.4	55.9	61.6	67.5	73.6	79.9	86.4	93.1	100.0	107.1	114.4	121.9	129.6	137.5	145.6	153.9	162.4	171.1	180.0
110	37.8	43.0	48.4	54.0	59.8	65.8	72.0	78.4	85.0	91.8	98.8	106.0	113.4	121.0	128.8	136.8	145.0	153.4	162.0	170.8	179.8
120	35.2	40.5	46.0	51.7	57.6	63.7	70.0	76.5	83.2	90.1	97.2	104.5	112.0	119.7	127.6	135.7	144.0	152.5	161.2	170.1	179.2
130	32.2	37.6	43.2	49.0	55.0	61.2	67.6	74.2	81.0	88.0	95.2	102.6	110.2	118.0	126.0	134.2	142.6	151.2	160.0	169.0	178.2
140	28.8	34.3	40.0	45.9	52.0	58.3	64.8	71.5	78.4	85.5	92.8	100.3	108.0	115.9	124.0	132.3	140.8	149.5	158.4	167.5	176.8
150	25.0	30.6	36.4	42.4	48.6	55.0	61.6	68.4	75.4	82.6	90.0	97.6	105.4	113.4	121.6	130.0	138.6	147.4	156.4	165.6	175.0
160	20.8	26.5	32.4	38.5	44.8	51.3	58.0	64.9	72.0	79.3	86.8	94.5	102.4	110.5	118.8	127.3	136.0	144.9	154.0	163.3	172.8
170	16.2	22.0	28.0	34.2	40.6	47.2	54.0	61.0	68.2	75.6	83.2	91.0	99.0	107.2	115.6	124.2	133.0	142.0	151.2	160.6	170.2
180	11.2	17.1	23.2	29.5	36.0	42.7	49.6	56.7	64.0	71.5	79.2	87.1	95.2	103.5	112.0	120.7	129.6	138.7	148.0	157.5	167.2
190	5.8	11.8	18.0	24.4	31.0	37.8	44.8	52.0	59.4	67.0	74.8	82.8	91.0	99.4	108.0	116.8	125.8	135.0	144.4	154.0	163.8
200	0.0	6.1	12.4	18.9	25.6	32.5	39.6	46.9	54.4	62.1	70.0	78.1	86.4	94.9	103.6	112.5	121.6	130.9	140.4	150.1	160.0

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
0	160.0	168.1	176.4	184.9	193.6	202.5	211.6	220.9	230.4	240.1	250.0	260.1	270.4	280.9	291.6	302.5	313.6	324.9	336.4	348.1	360.0
10	163.8	172.0	180.4	189.0	197.8	206.8	216.0	225.4	235.0	244.8	254.8	265.0	275.4	286.0	296.8	307.8	319.0	330.4	342.0	353.8	365.8
20	167.2	175.5	184.0	192.7	201.6	210.7	220.0	229.5	239.2	249.1	259.2	269.5	280.0	290.7	301.6	312.7	324.0	335.5	347.2	359.1	371.2
30	170.2	178.6	187.2	196.0	205.0	214.2	223.6	233.2	243.0	253.0	263.2	273.6	284.2	295.0	306.0	317.2	328.6	340.2	352.0	364.0	376.2
40	172.8	181.3	190.0	198.9	208.0	217.3	226.8	236.5	246.4	256.5	266.8	277.3	288.0	298.9	310.0	321.3	332.8	344.5	356.4	368.5	380.8
50	175.0	183.6	192.4	201.4	210.6	220.0	229.6	239.4	249.4	259.6	270.0	280.6	291.4	302.4	313.6	325.0	336.6	348.4	360.4	372.6	385.0
60	176.8	185.5	194.4	203.5	212.8	222.3	232.0	241.9	252.0	262.3	272.8	283.5	294.4	305.5	316.8	328.3	340.0	351.9	364.0	376.3	388.8
70	178.2	187.0	196.0	205.2	214.6	224.2	234.0	244.0	254.2	264.6	275.2	286.0	297.0	308.2	319.6	331.2	343.0	355.0	367.2	379.6	392.2
80	179.2	188.1	197.2	206.5	216.0	225.7	235.6	245.7	256.0	266.5	277.2	288.1	299.2	310.5	322.0	333.7	345.6	357.7	370.0	382.5	395.2
90	179.8	188.8	198.0	207.4	217.0	226.8	236.8	247.0	257.4	268.0	278.8	289.8	301.0	312.4	324.0	335.8	347.8	360.0	372.4	385.0	397.8
100	180.0	189.1	198.4	207.9	217.6	227.5	237.6	247.9	258.4	269.1	280.0	291.1	302.4	313.9	325.6	337.5	349.6	361.9	374.4	387.1	400.0
110	179.8	189.0	198.4	208.0	217.8	227.8	238.0	248.4	259.0	269.8	280.8	292.0	303.4	315.0	326.8	338.8	351.0	363.4	376.0	388.8	401.8
120	179.2	188.5	198.0	207.7	217.6	227.7	238.0	248.5	259.2	270.1	281.2	292.5	304.0	315.7	327.6	339.7	352.0	364.5	377.2	390.1	403.2
130	178.2	187.6	197.2	207.0	217.0	227.2	237.6	248.2	259.0	270.0	281.2	292.6	304.2	316.0	328.0	340.2	352.6	365.2	378.0	391.0	404.2
140	176.8	186.3	196.0	205.9	216.0	226.3	236.8	247.5	258.4	269.5	280.8	292.3	304.0	315.9	328.0	340.3	352.8	365.5	378.4	391.5	404.8
150	175.0	184.6	194.4	204.4	214.6	225.0	235.6	246.4	257.4	268.6	280.0	291.6	303.4	315.4	327.6	340.0	352.6	365.4	378.4	391.6	405.0
160	172.8	182.5	192.4	202.5	212.8	223.3	234.0	244.9	256.0	267.3	278.8	290.5	302.4	314.5	326.8	339.3	352.0	364.9	378.0	391.3	404.8
170	170.2	180.0	190.0	200.2	210.6	221.2	232.0	243.0	254.2	265.6	277.2	289.0	301.0	313.2	325.6	338.2	351.0	364.0	377.2	390.6	404.2
180	167.2	177.1	187.2	197.5	208.0	218.7	229.6	240.7	252.0	263.5	275.2	287.1	299.2	311.5	324.0	336.7	349.6	362.7	376.0	389.5	403.2
190	163.8	173.8	184.0	194.4	205.0	215.8	226.8	238.0	249.4	261.0	272.8	284.8	297.0	309.4	322.0	334.8	347.8	361.0	374.4	388.0	401.8
200	160.0	170.1	180.4	190.9	201.6	212.5	223.6	234.9	246.4	258.1	270.0	282.1	294.4	306.9	319.6	332.5	345.6	358.9	372.4	386.1	400.0

	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
0	360.0	372.1	384.4	396.9	409.6	422.5	435.6	448.9	462.4	476.1	490.0	504.1	518.4	532.9	547.6	562.5	577.6	592.9	608.4	624.1	640.0
10	365.8	378.0	390.4	403.0	415.8	428.8	442.0	455.4	469.0	482.8	496.8	511.0	525.4	540.0	554.8	569.8	585.0	600.4	616.0	631.8	647.8
20	371.2	383.5	396.0	408.7	421.6	434.7	448.0	461.5	475.2	489.1	503.2	517.5	532.0	546.7	561.6	576.7	592.0	607.5	623.2	639.1	655.2
30	376.2	388.6	401.2	414.0	427.0	440.2	453.6	467.2	481.0	495.0	509.2	523.6	538.2	553.0	568.0	583.2	598.6	614.2	630.0	646.0	662.2
40	380.8	393.3	406.0	418.9	432.0	445.3	458.8	472.5	486.4	500.5	514.8	529.3	544.0	558.9	574.0	589.3	604.8	620.5	636.4	652.5	668.8
50	385.0	397.6	410.4	423.4	436.6	450.0	463.6	477.4	491.4	505.6	520.0	534.6	549.4	564.4	579.6	595.0	610.6	626.4	642.4	658.6	675.0
60	388.8	401.5	414.4	427.5	440.8	454.3	468.0	481.9	496.0	510.3	524.8	539.5	554.4	569.5	584.8	600.3	616.0	631.9	648.0	664.3	680.8
70	392.2	405.0	418.0	431.2	444.6	458.2	472.0	486.0	500.2	514.6	529.2	544.0	559.0	574.2	589.6	605.2	621.0	637.0	653.2	669.6	686.2
80	395.2	408.1	421.2	434.5	448.0	461.7	475.6	489.7	504.0	518.5	533.2	548.1	563.2	578.5	594.0	609.7	625.6	641.7	658.0	674.5	691.2
90	397.8	410.8	424.0	437.4	451.0	464.8	478.8	493.0	507.4	522.0	536.8	551.8	567.0	582.4	598.0	613.8	629.8	646.0	662.4	679.0	695.8
100	400.0	413.1	426.4	439.9	453.6	467.5	481.6	495.9	510.4	525.1	540.0	555.1	570.4	585.9	601.6	617.5	633.6	649.9	666.4	683.1	700.0
110	401.8	415.0	428.4	442.0	455.8	469.8	484.0	498.4	513.0	527.8	542.8	558.0	573.4	589.0	604.8	620.8	637.0	653.4	670.0	686.8	703.8
120	403.2	416.5	430.0	443.7	457.6	471.7	486.0	500.5	515.2	530.1	545.2	560.5	576.0	591.7	607.6	623.7	640.0	656.5	673.2	690.1	707.2
130	404.2	417.6	431.2	445.0	459.0	473.2	487.6	502.2	517.0	532.0	547.2	562.6	578.2	594.0	610.0	626.2	642.6	659.2	676.0	693.0	710.2
140	404.8	418.3	432.0	445.9	460.0	474.3	488.8	503.5	518.4	533.5	548.8	564.3	580.0	595.9	612.0	628.3	644.8	661.5	678.4	695.5	712.8
150	405.0	418.6	432.4	446.4	460.6	475.0	489.6	504.4	519.4	534.6	550.0	565.6	581.4	597.4	613.6	630.0	646.6	663.4	680.4	697.6	715.0
160	404.8	418.5	432.4	446.5	460.8	475.3	490.0	504.9	520.0	535.3	550.8	566.5	582.4	598.5	614.8	631.3	648.0	664.9	682.0	699.3	716.8
170	404.2	418.0	432.0	446.2	460.6	475.2	490.0	505.0	520.2	535.6	551.2	567.0	583.0	599.2	615.6	632.2	649.0	666.0	683.2	700.6	718.2
180	403.2	417.1	431.2	445.5	460.0	474.7	489.6	504.7	520.0	535.5	551.2	567.1	583.2	599.5	616.0	632.7	649.6	666.7	684.0	701.5	719.2
190	401.8	415.8	430.0	444.4	459.0	473.8	488.8	504.0	519.4	535.0	550.8	566.8	583.0	599.4	616.0	632.8	649.8	667.0	684.4	702.0	719.8
200	400.0	414.1	428.4	442.9	457.6	472.5	487.6	502.9	518.4	534.1	550.0	566.1	582.4	598.9	615.6	632.5	649.6	666.9	684.4	702.1	720.0

DEFLECTION TABLE $a = 1$

	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
0	640.0	656.1	672.4	688.9	705.6	722.5	739.6	756.9	774.4	792.1	810.0	828.1	846.4	864.9	883.6	902.5	921.6	940.9	960.4	980.1	1000.0
10	647.8	664.0	680.4	697.0	713.8	730.8	748.0	765.4	783.0	800.8	818.8	837.0	855.4	874.0	892.8	911.8	931.0	950.4	970.0	989.8	1009.8
20	655.2	671.5	688.0	704.7	721.6	738.7	756.0	773.5	791.2	809.1	827.2	845.5	864.0	882.7	901.6	920.7	940.0	959.5	979.2	999.1	1019.2
30	662.2	678.6	695.2	712.0	729.0	746.2	763.6	781.2	799.0	817.0	835.2	853.6	872.2	891.0	910.0	929.2	948.6	968.2	988.0	1008.0	1028.2
40	668.8	685.3	702.0	718.9	736.0	753.3	770.8	788.5	806.4	824.5	842.8	861.3	880.0	898.9	918.0	937.3	956.8	976.5	996.4	1016.5	1036.8
50	675.0	691.6	708.4	725.4	742.6	760.0	777.6	795.4	813.4	831.6	850.0	868.6	887.4	906.4	925.6	945.0	964.6	984.4	1004.4	1024.6	1045.0
60	680.8	697.5	714.4	731.5	748.8	766.3	784.0	801.9	820.0	838.3	856.8	875.5	894.4	913.5	932.8	952.3	972.0	991.9	1012.0	1032.3	1052.8
70	686.2	703.0	720.0	737.2	754.6	772.2	790.0	808.0	826.2	844.6	863.2	882.0	901.0	920.2	939.6	959.2	979.0	999.0	1019.2	1039.6	1060.2
80	691.2	708.1	725.2	742.5	760.0	777.7	795.6	813.7	832.0	850.5	869.2	888.1	907.2	926.5	946.0	965.7	985.6	1005.7	1026.0	1046.5	1067.2
90	695.8	712.8	730.0	747.4	765.0	782.8	800.8	819.0	837.4	856.0	874.8	893.8	913.0	932.4	952.0	971.8	991.8	1012.0	1032.4	1053.0	1073.8
100	700.0	717.1	734.4	751.9	769.6	787.5	805.6	823.9	842.4	861.1	880.0	899.1	918.4	937.9	957.6	977.5	997.6	1017.9	1038.4	1059.1	1080.0
110	703.8	721.0	738.4	756.0	773.8	791.8	810.0	828.4	847.0	865.8	884.8	904.0	923.4	943.0	962.8	982.8	1003.0	1023.4	1044.0	1064.8	1085.8
120	707.2	724.5	742.0	759.7	777.6	795.7	814.0	832.5	851.2	870.1	889.2	908.5	928.0	947.7	967.6	987.7	1008.0	1028.5	1049.2	1070.1	1091.2
130	710.2	727.6	745.2	763.0	781.0	799.2	817.6	836.2	855.0	874.0	893.2	912.6	932.2	952.0	972.0	992.2	1012.6	1033.2	1054.0	1075.0	1096.2
140	712.8	730.3	748.0	765.9	784.0	802.3	820.8	839.5	858.4	877.5	896.8	916.3	936.0	955.9	976.0	996.3	1016.8	1037.5	1058.4	1079.5	1100.8
150	715.0	732.6	750.4	768.4	786.6	805.0	823.6	842.4	861.4	880.6	900.0	919.6	939.4	959.4	979.6	1000.0	1020.6	1041.4	1062.4	1083.6	1105.0
160	716.8	734.5	752.4	770.5	788.8	807.3	826.0	844.9	864.0	883.3	902.8	922.5	942.4	962.5	982.8	1003.3	1024.0	1044.9	1066.0	1087.3	1108.8
170	718.2	736.0	754.0	772.2	790.6	809.2	828.0	847.0	866.2	885.6	905.2	925.0	945.0	965.2	985.6	1006.2	1027.0	1048.0	1069.2	1090.6	1112.2
180	719.2	737.1	755.2	773.5	792.0	810.7	829.6	848.7	868.0	887.5	907.2	927.1	947.2	967.5	988.0	1008.7	1029.6	1050.7	1072.0	1093.5	1115.2
190	719.8	737.8	756.0	774.4	793.0	811.8	830.8	850.0	869.4	889.0	908.8	928.8	949.0	969.4	990.0	1010.8	1031.8	1053.0	1074.4	1096.0	1117.8
200	720.0	738.1	756.4	774.9	793.6	812.5	831.6	850.9	870.4	890.1	910.0	930.1	950.4	970.9	991.6	1012.5	1033.6	1054.9	1076.4	1098.1	1120.0

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
210	88.2	86.0	83.6	81.0	78.2	75.2	72.0	68.6	65.0	61.2	57.2	53.0	48.6	44.0	39.2	34.2	29.0	23.6	18.0	12.2	6.2
220	96.8	94.5	92.0	89.3	86.4	83.3	80.0	76.5	72.8	68.9	64.8	60.5	56.0	51.3	46.4	41.3	36.0	30.5	24.8	18.9	12.8
230	105.8	103.4	100.8	98.0	95.0	91.8	88.4	84.8	81.0	77.0	72.8	68.4	63.8	59.0	54.0	48.8	43.4	37.8	32.0	26.0	19.8
240	115.2	112.7	110.0	107.1	104.0	100.7	97.2	93.5	89.6	85.5	81.2	76.7	72.0	67.1	62.0	56.7	51.2	45.5	39.6	33.5	27.2
250	125.0	122.4	119.6	116.6	113.4	110.0	106.4	102.6	98.6	94.4	90.0	85.4	80.6	75.6	70.4	65.0	59.4	53.6	47.6	41.4	35.0
260	135.2	132.5	129.6	126.5	123.2	119.7	116.0	112.1	108.0	103.7	99.2	94.5	89.6	84.5	79.2	73.7	68.0	62.1	56.0	49.7	43.2
270	145.8	143.0	140.0	136.8	133.4	129.8	126.0	122.0	117.8	113.4	108.8	104.0	99.0	93.8	88.4	82.8	77.0	71.0	64.8	58.4	51.8
280	156.8	153.9	150.8	147.5	144.0	140.3	136.4	132.3	128.0	123.5	118.8	113.9	108.8	103.5	98.0	92.3	86.4	80.3	74.0	67.5	60.8
290	168.2	165.2	162.0	158.6	155.0	151.2	147.2	143.0	138.6	134.0	129.2	124.2	119.0	113.6	108.0	102.2	96.2	90.0	83.6	77.0	70.2
300	180.0	176.9	173.6	170.1	166.4	162.5	158.4	154.1	149.6	144.9	140.0	134.9	129.6	124.1	118.4	112.5	106.4	100.1	93.6	86.9	80.0
310	192.2	189.0	185.6	182.0	178.2	174.2	170.0	165.6	161.0	156.2	151.2	146.0	140.6	135.0	129.2	123.2	117.0	110.6	104.0	97.2	90.2
320	204.8	201.5	198.0	194.3	190.4	186.3	182.0	177.5	172.8	167.9	162.8	157.5	152.0	146.3	140.4	134.3	128.0	121.5	114.8	107.9	100.8
330	217.8	214.4	210.8	207.0	203.0	198.8	194.4	189.8	185.0	180.0	174.8	169.4	163.8	158.0	152.0	145.8	139.4	132.8	126.0	119.0	111.8
340	231.2	227.7	224.0	220.1	216.0	211.7	207.2	202.5	197.6	192.5	187.2	181.7	176.0	170.1	164.0	157.7	151.2	144.5	137.6	130.5	123.2
350	245.0	241.4	237.6	233.6	229.4	225.0	220.4	215.6	210.6	205.4	200.0	194.4	188.6	182.6	176.4	170.0	163.4	156.6	149.6	142.4	135.0
360	259.2	255.5	251.6	247.5	243.2	238.7	234.0	229.1	224.0	218.7	213.2	207.5	201.6	195.5	189.2	182.7	176.0	169.1	162.0	154.7	147.2
370	273.8	270.0	266.0	261.8	257.4	252.8	248.0	243.0	237.8	232.4	226.8	221.0	215.0	208.8	202.4	195.8	189.0	182.0	174.8	167.4	159.8
380	288.8	284.9	280.8	276.5	272.0	267.3	262.4	257.3	252.0	246.5	240.8	234.9	228.8	222.5	216.0	209.3	202.4	195.3	188.0	180.5	172.8
390	304.2	300.2	296.0	291.6	287.0	282.2	277.2	272.0	266.6	261.0	255.2	249.2	243.0	236.6	230.0	223.2	216.2	209.0	201.6	194.0	186.2
400	320.0	315.9	311.6	307.1	302.4	297.5	292.4	287.1	281.6	275.9	270.0	263.9	257.6	251.1	244.4	237.5	230.4	223.1	215.6	207.9	200.0

DEFLECTION TABLE

$a = 1$

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
210	6.2	0.0	6.4	13.0	19.8	26.8	34.0	41.4	49.0	56.8	64.8	73.0	81.4	90.0	98.8	107.8	117.0	126.4	136.0	145.8	155.8
220	12.8	6.5	0.0	6.7	13.6	20.7	28.0	35.5	43.2	51.1	59.2	67.5	76.0	84.7	93.6	102.7	112.0	121.5	131.2	141.1	151.2
230	19.8	13.4	6.8	0.0	7.0	14.2	21.6	29.2	37.0	45.0	53.2	61.6	70.2	79.0	88.0	97.2	106.6	116.2	126.0	136.0	146.2
240	27.2	20.7	14.0	7.1	0.0	7.3	14.8	22.5	30.4	38.5	46.8	55.3	64.0	72.9	82.0	91.3	100.8	110.5	120.4	130.5	140.8
250	35.0	28.4	21.6	14.6	7.4	0.0	7.6	15.4	23.4	31.6	40.0	48.6	57.4	66.4	75.6	85.0	94.6	104.4	114.4	124.6	135.0
260	43.2	36.5	29.6	22.5	15.2	7.7	0.0	7.9	16.0	24.3	32.8	41.5	50.4	59.5	68.8	78.3	88.0	97.9	108.0	118.3	128.8
270	51.8	45.0	38.0	30.8	23.4	15.8	8.0	0.0	8.2	16.6	25.2	34.0	43.0	52.2	61.6	71.2	81.0	91.0	101.2	111.6	122.2
280	60.8	53.9	46.8	39.5	32.0	24.3	16.4	8.3	0.0	8.5	17.2	26.1	35.2	44.5	54.0	63.7	73.6	83.7	94.0	104.5	115.2
290	70.2	63.2	56.0	48.6	41.0	33.2	25.2	17.0	8.6	0.0	8.8	17.8	27.0	36.4	46.0	55.8	65.8	76.0	86.4	97.0	107.8
300	80.0	72.9	65.6	58.1	50.4	42.5	34.4	26.1	17.6	8.9	0.0	9.1	18.4	27.9	37.6	47.5	57.6	67.9	78.4	89.1	100.0
310	90.2	83.0	75.6	68.0	60.2	52.2	44.0	35.6	27.0	18.2	9.2	0.0	9.4	19.0	28.8	38.8	49.0	59.4	70.0	80.8	91.8
320	100.8	93.5	86.0	78.3	70.4	62.3	54.0	45.5	36.8	27.9	18.8	9.5	0.0	9.7	19.6	29.7	40.0	50.5	61.2	72.1	83.2
330	111.8	104.4	96.8	89.0	81.0	72.8	64.4	55.8	47.0	38.0	28.8	19.4	9.8	0.0	10.0	20.2	30.6	41.2	52.0	63.0	74.2
340	123.2	115.7	108.0	100.1	92.0	83.7	75.2	66.5	57.6	48.5	39.2	29.7	20.0	10.1	0.0	10.3	20.8	31.5	42.4	53.5	64.8
350	135.0	127.4	119.6	111.6	103.4	95.0	86.4	77.6	68.6	59.4	50.0	40.4	30.6	20.6	10.4	0.0	10.6	21.4	32.4	43.6	55.0
360	147.2	139.5	131.6	123.5	115.2	106.7	98.0	89.1	80.0	70.7	61.2	51.5	41.6	31.5	21.2	10.7	0.0	10.9	22.0	33.3	44.8
370	159.8	152.0	144.0	135.8	127.4	118.8	110.0	101.0	91.8	82.4	72.8	63.0	53.0	42.8	32.4	21.8	11.0	0.0	11.2	22.6	34.2
380	172.8	164.9	156.8	148.5	140.0	131.3	122.4	113.3	104.0	94.5	84.8	74.9	64.8	54.5	44.0	33.3	22.4	11.3	0.0	11.5	23.2
390	186.2	178.2	170.0	161.6	153.0	144.2	135.2	126.0	116.6	107.0	97.2	87.2	77.0	66.6	56.0	45.2	34.2	23.0	11.6	0.0	11.8
400	200.0	191.9	183.6	175.1	166.4	157.5	148.4	139.1	129.6	119.9	110.0	99.9	89.6	79.1	68.4	57.5	46.4	35.1	23.6	11.9	0.0

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
210	155.8	166.0	176.4	187.0	197.8	208.8	220.0	231.4	243.0	254.8	266.8	279.0	291.4	304.0	316.8	329.8	343.0	356.4	370.0	383.8	397.8
220	151.2	161.5	172.0	182.7	193.6	204.7	216.0	227.5	239.2	251.1	263.2	275.5	288.0	300.7	313.6	326.7	340.0	353.5	367.2	381.1	395.2
230	146.2	156.6	167.2	178.0	189.0	200.2	211.6	223.2	235.0	247.0	259.2	271.6	284.2	297.0	310.0	323.2	336.6	350.2	364.0	378.0	392.2
240	140.8	151.3	162.0	172.9	184.0	195.3	206.8	218.5	230.4	242.5	254.8	267.3	280.0	292.9	306.0	319.3	332.8	346.5	360.4	374.5	388.8
250	135.0	145.6	156.4	167.4	178.6	190.0	201.6	213.4	225.4	237.6	250.0	262.6	275.4	288.4	301.6	315.0	328.6	342.4	356.4	370.6	385.0
260	128.8	139.5	150.4	161.5	172.8	184.3	196.0	207.9	220.0	232.3	244.8	257.5	270.4	283.5	296.8	310.3	324.0	337.9	352.0	366.3	380.8
270	122.2	133.0	144.0	155.2	166.6	178.2	190.0	202.0	214.2	226.6	239.2	252.0	265.0	278.2	291.6	305.2	319.0	333.0	347.2	361.6	376.2
280	115.2	126.1	137.2	148.5	160.0	171.7	183.6	195.7	208.0	220.5	233.2	246.1	259.2	272.5	286.0	299.7	313.6	327.7	342.0	356.5	371.2
290	107.8	118.8	130.0	141.4	153.0	164.8	176.8	189.0	201.4	214.0	226.8	239.8	253.0	266.4	280.0	293.8	307.8	322.0	336.4	351.0	365.8
300	100.0	111.1	122.4	133.9	145.6	157.5	169.6	181.9	194.4	207.1	220.0	233.1	246.4	259.9	273.6	287.5	301.6	315.9	330.4	345.1	360.0
310	91.8	103.0	114.4	126.0	137.8	149.8	162.0	174.4	187.0	199.8	212.8	226.0	239.4	253.0	266.8	280.8	295.0	309.4	324.0	338.8	353.8
320	83.2	94.5	106.0	117.7	129.6	141.7	154.0	166.5	179.2	192.1	205.2	218.5	232.0	245.7	259.6	273.7	288.0	302.5	317.2	332.1	347.2
330	74.2	85.6	97.2	109.0	121.0	133.2	145.6	158.2	171.0	184.0	197.2	210.6	224.2	238.0	252.0	266.2	280.6	295.2	310.0	325.0	340.2
340	64.8	76.3	88.0	99.9	112.0	124.3	136.8	149.5	162.4	175.5	188.8	202.3	216.0	229.9	244.0	258.3	272.8	287.5	302.4	317.5	332.8
350	55.0	66.6	78.4	90.4	102.6	115.0	127.6	140.4	153.4	166.6	180.0	193.6	207.4	221.4	235.6	250.0	264.6	279.4	294.4	309.6	325.0
360	44.8	56.5	68.4	80.5	92.8	105.3	118.0	130.9	144.0	157.3	170.8	184.5	198.4	212.5	226.8	241.3	256.0	270.9	286.0	301.3	316.8
370	34.2	46.0	58.0	70.2	82.6	95.2	108.0	121.0	134.2	147.6	161.2	175.0	189.0	203.2	217.6	232.2	247.0	262.0	277.2	292.6	308.2
380	23.2	35.1	47.2	59.5	72.0	84.7	97.6	110.7	124.0	137.5	151.2	165.1	179.2	193.5	208.0	222.7	237.6	252.7	268.0	283.5	299.2
390	11.8	23.8	36.0	48.4	61.0	73.8	86.8	100.0	113.4	127.0	140.8	154.8	169.0	183.4	198.0	212.8	227.8	243.0	258.4	274.0	289.8
400	0.0	12.1	24.4	36.9	49.6	62.5	75.6	88.9	102.4	116.1	130.0	144.1	158.4	172.9	187.6	202.5	217.6	232.9	248.4	264.1	280.0

	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
210	397.8	412.0	426.4	441.0	455.8	470.8	486.0	501.4	517.0	532.8	548.8	565.0	581.4	598.0	614.8	631.8	649.0	666.4	684.0	701.8	719.8
220	395.2	409.5	424.0	438.7	453.6	468.7	484.0	499.5	515.2	531.1	547.2	563.5	580.0	596.7	613.6	630.7	648.0	665.5	683.2	701.1	719.2
230	392.2	406.6	421.2	436.0	451.0	466.2	481.6	497.2	513.0	529.0	545.2	561.6	578.2	595.0	612.0	629.2	646.6	664.2	682.0	700.0	718.2
240	388.8	403.3	418.0	432.9	448.0	463.3	478.8	494.5	510.4	526.5	542.8	559.3	576.0	592.9	610.0	627.3	644.8	662.5	680.4	698.5	716.8
250	385.0	399.6	414.4	429.4	444.6	460.0	475.6	491.4	507.4	523.6	540.0	556.6	573.4	590.4	607.6	625.0	642.6	660.4	678.4	696.6	715.0
260	380.8	395.5	410.4	425.5	440.8	456.3	472.0	487.9	504.0	520.3	536.8	553.5	570.4	587.5	604.8	622.3	640.0	657.9	676.0	694.3	712.8
270	376.2	391.0	406.0	421.2	436.6	452.2	468.0	484.0	500.2	516.6	533.2	550.0	567.0	584.2	601.6	619.2	637.0	655.0	673.2	691.6	710.2
280	371.2	386.1	401.2	416.5	432.0	447.7	463.6	479.7	496.0	512.5	529.2	546.1	563.2	580.5	598.0	615.7	633.6	651.7	670.0	688.5	707.2
290	365.8	380.8	396.0	411.4	427.0	442.8	458.8	475.0	491.4	508.0	524.8	541.8	559.0	576.4	594.0	611.8	629.8	648.0	666.4	685.0	703.8
300	360.0	375.1	390.4	405.9	421.6	437.5	453.6	469.9	486.4	503.1	520.0	537.1	554.4	571.9	589.6	607.5	625.6	643.9	662.4	681.1	700.0
310	353.8	369.0	384.4	400.0	415.8	431.8	448.0	464.4	481.0	497.8	514.8	532.0	549.4	567.0	584.8	602.8	621.0	639.4	658.0	676.8	695.8
320	347.2	362.5	378.0	393.7	409.6	425.7	442.0	458.5	475.2	492.1	509.2	526.5	544.0	561.7	579.6	597.7	616.0	634.5	653.2	672.1	691.2
330	340.2	355.6	371.2	387.0	403.0	419.2	435.6	452.2	469.0	486.0	503.2	520.6	538.2	556.0	574.0	592.2	610.6	629.2	648.0	667.0	686.2
340	332.8	348.3	364.0	379.9	396.0	412.3	428.8	445.5	462.4	479.5	496.8	514.3	532.0	549.9	568.0	586.3	604.8	623.5	642.4	661.5	680.8
350	325.0	340.6	356.4	372.4	388.6	405.0	421.6	438.4	455.4	472.6	490.0	507.6	525.4	543.4	561.6	580.0	598.6	617.4	636.4	655.6	675.0
360	316.8	332.5	348.4	364.5	380.8	397.3	414.0	430.9	448.0	465.3	482.8	500.5	518.4	536.5	554.8	573.3	592.0	610.9	630.0	649.3	668.8
370	308.2	324.0	340.0	356.2	372.6	389.2	406.0	423.0	440.2	457.6	475.2	493.0	511.0	529.2	547.6	566.2	585.0	604.0	623.2	642.6	662.2
380	299.2	315.1	331.2	347.5	364.0	380.7	397.6	414.7	432.0	449.5	467.2	485.1	503.2	521.5	540.0	558.7	577.6	596.7	616.0	635.5	655.2
390	289.8	305.8	322.0	338.4	355.0	371.8	388.8	406.0	423.4	441.0	458.8	476.8	495.0	513.4	532.0	550.8	569.8	589.0	608.4	628.0	647.8
400	280.0	296.1	312.4	328.9	345.6	362.5	379.6	396.9	414.4	432.1	450.0	468.1	486.4	504.9	523.6	542.5	561.6	580.9	600.4	620.1	640.0

-	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
210	719.8	738.0	756.4	775.0	793.8	812.8	832.0	851.4	871.0	890.8	910.8	931.0	951.4	972.0	992.8	1013.8	1035.0	1056.4	1078.0	1099.8	1121.8
220	719.2	737.5	756.0	774.7	793.6	812.7	832.0	851.5	871.2	891.1	911.2	931.5	952.0	972.7	993.6	1014.7	1036.0	1057.5	1079.2	1101.1	1123.2
230	718.2	736.6	755.2	774.0	793.0	812.2	831.6	851.2	871.0	891.0	911.2	931.6	952.2	973.0	994.0	1015.2	1036.6	1058.2	1080.0	1102.0	1124.2
240	716.8	735.3	754.0	772.9	792.0	811.3	830.8	850.5	870.4	890.5	910.8	931.3	952.0	972.9	994.0	1015.3	1036.8	1058.5	1080.4	1102.5	1124.8
250	**715.0**	**733.6**	**752.4**	**771.4**	**790.6**	**810.0**	**829.6**	**849.4**	**869.4**	**889.6**	**910.0**	**930.6**	**951.4**	**972.4**	**993.6**	**1015.0**	**1036.6**	**1058.4**	**1080.4**	**1102.6**	**1125.0**
260	712.8	731.5	750.4	769.5	788.8	808.3	828.0	847.9	868.0	888.3	908.8	929.5	950.4	971.5	992.8	1014.3	1036.0	1057.9	1080.0	1102.3	1124.8
270	710.2	729.0	748.0	767.2	786.6	806.2	826.0	846.0	866.2	886.6	907.2	928.0	949.0	970.2	991.6	1013.2	1035.0	1057.0	1079.2	1101.6	1124.2
280	707.2	726.1	745.2	764.5	784.0	803.7	823.6	843.7	864.0	884.5	905.2	926.1	947.2	968.5	990.0	1011.7	1033.6	1055.7	1078.0	1100.5	1123.2
290	703.8	722.8	742.0	761.4	781.0	800.8	820.8	841.0	861.4	882.0	902.8	923.8	945.0	966.4	988.0	1009.8	1031.8	1054.0	1076.4	1099.0	1121.8
300	**700.0**	**719.1**	**738.4**	**757.9**	**777.6**	**797.5**	**817.6**	**837.9**	**858.4**	**879.1**	**900.0**	**921.1**	**942.4**	**963.9**	**985.6**	**1007.5**	**1029.6**	**1051.9**	**1074.4**	**1097.1**	**1120.0**
310	695.8	715.0	734.4	754.0	773.8	793.8	814.0	834.4	855.0	875.8	896.8	918.0	939.4	961.0	982.8	1004.8	1027.0	1049.4	1072.0	1094.8	1117.8
320	691.2	710.5	730.0	749.7	769.6	789.7	810.0	830.5	851.2	872.1	893.2	914.5	936.0	957.7	979.6	1001.7	1024.0	1046.5	1069.2	1092.1	1115.2
330	686.2	705.6	725.2	745.0	765.0	785.2	805.6	826.2	847.0	868.0	889.2	910.6	932.2	954.0	976.0	998.2	1020.6	1043.2	1066.0	1089.0	1112.2
340	680.8	700.3	720.0	739.9	760.0	780.3	800.8	821.5	842.4	863.5	884.8	906.3	928.0	949.9	972.0	994.3	1016.8	1039.5	1062.4	1085.5	1108.8
350	**675.0**	**694.6**	**714.4**	**734.4**	**754.6**	**775.0**	**795.6**	**816.4**	**837.4**	**858.6**	**880.0**	**901.6**	**923.4**	**945.4**	**967.6**	**990.0**	**1012.6**	**1035.4**	**1058.4**	**1081.6**	**1105.0**
360	668.8	688.5	708.4	728.5	748.8	769.3	790.0	810.9	832.0	853.3	874.8	896.5	918.4	940.5	962.8	985.3	1008.0	1030.9	1054.0	1077.3	1100.8
370	662.2	682.0	702.0	722.2	742.6	763.2	784.0	805.0	826.2	847.6	869.2	891.0	913.0	935.2	957.6	980.2	1003.0	1026.0	1049.2	1072.6	1096.2
380	655.2	675.1	695.2	715.5	736.0	756.7	777.6	798.7	820.0	841.5	863.2	885.1	907.2	929.5	952.0	974.7	997.6	1020.7	1044.0	1067.5	1091.2
390	647.8	667.8	688.0	708.4	729.0	749.8	770.8	792.0	813.4	835.0	856.8	878.8	901.0	923.4	946.0	968.8	991.8	1015.0	1038.4	1062.0	1085.8
400	640.0	660.1	680.4	700.9	721.6	742.5	763.6	784.9	806.4	828.1	850.0	872.1	894.4	916.9	939.6	962.5	985.6	1008.9	1032.4	1056.1	1080.0

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
410	336.2	332.0	327.6	323.0	318.2	313.2	308.0	302.6	297.0	291.2	285.2	279.0	272.6	266.0	259.2	252.2	245.0	237.6	230.0	222.2	214.2
420	352.8	348.5	344.0	339.3	334.4	329.3	324.0	318.5	312.8	306.9	300.8	294.5	288.0	281.3	274.4	267.3	260.0	252.5	244.8	236.9	228.8
430	369.8	365.4	360.8	356.0	351.0	345.8	340.4	334.8	329.0	323.0	316.8	310.4	303.8	297.0	290.0	282.8	275.4	267.8	260.0	252.0	243.8
440	387.2	382.7	378.0	373.1	368.0	362.7	357.2	351.5	345.6	339.5	333.2	326.7	320.0	313.1	306.0	298.7	291.2	283.5	275.6	267.5	259.2
450	404.9	400.3	395.5	390.5	385.3	379.9	374.3	368.5	362.5	356.3	349.9	343.3	336.5	329.5	322.3	314.9	307.3	299.5	291.5	283.3	274.9
460	423.1	418.4	413.5	408.4	403.1	397.6	391.9	386.0	379.9	373.6	367.1	360.4	353.5	346.4	339.1	331.6	323.9	316.0	307.9	299.6	291.1
470	441.7	436.9	431.9	426.7	421.3	415.7	409.9	403.9	397.7	391.3	384.7	377.9	370.9	363.7	356.3	348.7	340.9	332.9	324.7	316.3	307.7
480	460.7	455.8	450.7	445.4	439.9	434.2	428.3	422.2	415.9	409.4	402.7	395.8	388.7	381.4	373.9	366.2	358.3	350.2	341.9	333.4	324.7
490	480.1	475.1	469.9	464.5	458.9	453.1	447.1	440.9	434.5	427.9	421.1	414.1	406.9	399.5	391.9	384.1	376.1	367.9	359.5	350.9	342.1
500	499.9	494.8	489.5	484.0	478.3	472.4	466.3	460.0	453.5	446.8	439.9	432.8	425.5	418.0	410.3	402.4	394.3	386.0	377.5	368.8	359.9
510	520.1	514.9	509.5	503.9	498.1	492.1	485.9	479.5	472.9	466.1	459.1	451.9	444.5	436.9	429.1	421.1	412.9	404.5	395.9	387.1	378.1
520	540.7	535.4	529.9	524.2	518.3	512.2	505.9	499.4	492.7	485.8	478.7	471.4	463.9	456.2	448.3	440.2	431.9	423.4	414.7	405.8	396.7
530	561.7	556.3	550.7	544.9	538.9	532.7	526.3	519.7	512.9	505.9	498.7	491.3	483.7	475.9	467.9	459.7	451.3	442.7	433.9	424.9	415.7
540	583.0	577.5	571.8	565.9	559.8	553.5	547.0	540.3	533.4	526.3	519.0	511.5	503.8	495.9	487.8	479.5	471.0	462.3	453.4	444.3	435.0
550	604.8	599.2	593.4	587.4	581.2	574.8	568.2	561.4	554.4	547.2	539.8	532.2	524.4	516.4	508.2	499.8	491.2	482.4	473.4	464.2	454.8
560	627.0	621.3	615.4	609.3	603.0	596.5	589.8	582.9	575.8	568.5	561.0	553.3	545.4	537.3	529.0	520.5	511.8	502.9	493.8	484.5	475.0
570	649.6	643.8	637.8	631.6	625.2	618.6	611.8	604.8	597.6	590.2	582.6	574.8	566.8	558.6	550.2	541.6	532.8	523.8	514.6	505.2	495.6
580	672.6	666.7	660.6	654.3	647.8	641.1	634.2	627.1	619.8	612.3	604.6	596.7	588.6	580.3	571.8	563.1	554.2	545.1	535.8	526.3	516.6
590	695.9	689.9	683.7	677.3	670.7	663.9	656.9	649.7	642.3	634.7	626.9	618.9	610.7	602.3	593.7	584.9	575.9	566.7	557.3	547.7	537.9
600	719.7	713.6	707.3	700.8	694.1	687.2	680.1	672.8	665.3	657.6	649.7	641.6	633.3	624.8	616.1	607.2	598.1	588.8	579.3	569.6	559.7

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
410	214.2	206.0	197.6	189.0	180.2	171.2	162.0	152.6	143.0	133.2	123.2	113.0	102.6	92.0	81.2	70.2	59.0	47.6	36.0	24.2	12.2
420	228.8	220.5	212.0	203.3	194.4	185.3	176.0	166.5	156.8	146.9	136.8	126.5	116.0	105.3	94.4	83.3	72.0	60.5	48.8	36.9	24.8
430	243.8	235.4	226.8	218.0	209.0	199.8	190.4	180.8	171.0	161.0	150.8	140.4	129.8	119.0	108.0	96.8	85.4	73.8	62.0	50.0	37.8
440	259.2	250.7	242.0	233.1	224.0	214.7	205.2	195.5	185.6	175.5	165.2	154.7	144.0	133.1	122.0	110.7	99.2	87.5	75.6	63.5	51.2
450	274.9	266.3	257.5	248.5	239.3	229.9	220.3	210.5	200.5	190.3	179.9	169.3	158.5	147.5	136.3	124.9	113.3	101.5	89.5	77.3	64.9
460	291.1	282.4	273.5	264.4	255.1	245.6	235.9	226.0	215.9	205.6	195.1	184.4	173.5	162.4	151.1	139.6	127.9	116.0	103.9	91.6	79.1
470	307.7	298.9	289.9	280.7	271.3	261.7	251.9	241.9	231.7	221.3	210.7	199.9	188.9	177.7	166.3	154.7	142.9	130.9	118.7	106.3	93.7
480	324.7	315.8	306.7	297.4	287.9	278.2	268.3	258.2	247.9	237.4	226.7	215.8	204.7	193.4	181.9	170.2	158.3	146.2	133.9	121.4	108.7
490	342.1	333.1	323.9	314.5	304.9	295.1	285.1	274.9	264.5	253.9	243.1	232.1	220.9	209.5	197.9	186.1	174.1	161.9	149.5	136.9	124.1
500	359.9	350.8	341.5	332.0	322.3	312.4	302.3	292.0	281.5	270.8	259.9	248.8	237.5	226.0	214.3	202.4	190.3	178.0	165.5	152.8	139.9
510	378.1	368.9	359.5	349.9	340.1	330.1	319.9	309.5	298.9	288.1	277.1	265.9	254.5	242.9	231.1	219.1	206.9	194.5	181.9	169.1	156.1
520	396.7	387.4	377.9	368.2	358.3	348.2	337.9	327.4	316.7	305.8	294.7	283.4	271.9	260.2	248.3	236.2	223.9	211.4	198.7	185.8	172.7
530	415.7	406.3	396.7	386.9	376.9	366.7	356.3	345.7	334.9	323.9	312.7	301.3	289.7	277.9	265.9	253.7	241.3	228.7	215.9	202.9	189.7
540	435.0	425.5	415.8	405.9	395.8	385.5	375.0	364.3	353.4	342.3	331.0	319.5	307.8	295.9	283.8	271.5	259.0	246.3	233.4	220.3	207.0
550	454.8	445.2	435.4	425.4	415.2	404.8	394.2	383.4	372.4	361.2	349.8	338.2	326.4	314.4	302.2	289.8	277.2	264.4	251.4	238.2	224.8
560	475.0	465.3	455.4	445.3	435.0	424.5	413.8	402.9	391.8	380.5	369.0	357.3	345.4	333.3	321.0	308.5	295.8	282.9	269.8	256.5	243.0
570	495.6	485.8	475.8	465.6	455.2	444.6	433.8	422.8	411.6	400.2	388.6	376.8	364.8	352.6	340.2	327.6	314.8	301.8	288.6	275.2	261.6
580	516.6	506.7	496.6	486.3	475.8	465.1	454.2	443.1	431.8	420.3	408.6	396.7	384.6	372.3	359.8	347.1	334.2	321.1	307.8	294.3	280.6
590	537.9	527.9	517.7	507.3	496.7	485.9	474.9	463.7	452.3	440.7	428.9	416.9	404.7	392.3	379.7	366.9	353.9	340.7	327.3	313.7	299.9
600	559.7	549.6	539.3	528.8	518.1	507.2	496.1	484.8	473.3	461.6	449.7	437.6	425.3	412.8	400.1	387.2	374.1	360.8	347.3	333.6	319.7

DEFLECTION TABLE

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	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
410	12.2	0.0	12.4	25.0	37.8	50.8	64.0	77.4	91.0	104.8	118.8	133.0	147.4	162.0	176.8	191.8	207.0	222.4	238.0	253.8	269.8
420	24.8	12.5	0.0	12.7	25.6	38.7	52.0	65.5	79.2	93.1	107.2	121.5	136.0	150.7	165.6	180.7	196.0	211.5	227.2	243.1	259.2
430	37.8	25.4	12.8	0.0	13.0	26.2	39.6	53.2	67.0	81.0	95.2	109.6	124.2	139.0	154.0	169.2	184.6	200.2	216.0	232.0	248.2
440	51.2	38.7	26.0	13.1	0.0	13.3	26.8	40.5	54.4	68.5	82.8	97.3	112.0	126.9	142.0	157.3	172.8	188.5	204.4	220.5	236.8
450	64.9	52.3	39.5	26.5	13.3	0.0	13.5	27.3	41.3	55.5	69.9	84.5	99.3	114.3	129.5	144.9	160.5	176.3	192.3	208.5	224.9
460	79.1	66.4	53.5	40.4	27.1	13.6	0.0	13.8	27.9	42.2	56.7	71.4	86.3	101.4	116.7	132.2	147.9	163.8	179.9	196.2	212.7
470	93.7	80.9	67.9	54.7	41.3	27.7	13.9	0.0	14.1	28.5	43.1	57.9	72.9	88.1	103.5	119.1	134.9	150.9	167.1	183.5	200.1
480	108.7	95.8	82.7	69.4	55.9	42.2	28.3	14.2	0.0	14.4	29.1	44.0	59.1	74.4	89.9	105.6	121.5	137.6	153.9	170.4	187.1
490	124.1	111.1	97.9	84.5	70.9	57.1	43.1	28.9	14.5	0.0	14.7	29.7	44.9	60.3	75.9	91.7	107.7	123.9	140.3	156.9	173.7
500	139.9	126.8	113.5	100.0	86.3	72.4	58.3	44.0	29.5	14.8	0.0	15.0	30.3	45.8	61.5	77.4	93.5	109.8	126.3	143.0	159.9
510	156.1	142.9	129.5	115.9	102.1	88.1	73.9	59.5	44.9	30.1	15.1	0.0	15.3	30.9	46.7	62.7	78.9	95.3	111.9	128.7	145.7
520	172.7	159.4	145.9	132.2	118.3	104.2	89.9	75.4	60.7	45.8	30.7	15.4	0.0	15.6	31.5	47.6	63.9	80.4	97.1	114.0	131.1
530	189.7	176.3	162.7	148.9	134.9	120.7	106.3	91.7	76.9	61.9	46.7	31.3	15.7	0.0	15.9	32.1	48.5	65.1	81.9	98.9	116.1
540	207.0	193.5	179.8	165.9	151.8	137.5	123.0	108.3	93.4	78.3	63.0	47.5	31.8	15.9	0.0	16.1	32.6	49.3	66.2	83.3	100.6
550	224.8	211.2	197.4	183.4	169.2	154.8	140.2	125.4	110.4	95.2	79.8	64.2	48.4	32.4	16.2	0.0	16.4	33.2	50.2	67.4	84.8
560	243.0	229.3	215.4	201.3	187.0	172.5	157.8	142.9	127.8	112.5	97.0	81.3	65.4	49.3	33.0	16.5	0.0	16.7	33.8	51.1	68.6
570	261.6	247.8	233.8	219.6	205.2	190.6	175.8	160.8	145.6	130.2	114.6	98.8	82.8	66.6	50.2	33.6	16.8	0.0	17.0	34.4	52.0
580	280.6	266.7	252.6	238.3	223.8	209.1	194.2	179.1	163.8	148.3	132.6	116.7	100.6	84.3	67.8	51.1	34.2	17.1	0.0	17.3	35.0
590	299.9	285.9	271.7	257.3	242.7	227.9	212.9	197.7	182.3	166.7	150.9	134.9	118.7	102.3	85.7	68.9	51.9	34.7	17.3	0.0	17.5
600	319.7	305.6	291.3	276.8	262.1	247.2	232.1	216.8	201.3	185.6	169.7	153.6	137.3	120.8	104.1	87.2	70.1	52.8	35.3	17.6	0.0

DEFLECTION TABLE $s = 1$

	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
410	269.8	286.0	302.4	319.0	335.8	352.8	370.0	387.4	405.0	422.8	440.8	459.0	477.4	496.0	514.8	533.8	553.0	572.4	592.0	611.8	631.8
420	259.2	275.5	292.0	308.7	325.6	342.7	360 0	377.5	395.2	413.1	431.2	449.5	468.0	486.7	505.6	524.7	544.0	563.5	583.2	603.1	623.2
430	248.2	264.6	281.2	298.0	315.0	332.2	349.6	367.2	385.0	403.0	421.2	439.6	458.2	477.0	496.0	515.2	534.6	554.2	574.0	594.0	614.2
440	236.8	253.3	270.0	286.9	304.0	321.3	338.8	356.5	374.4	392.5	410.8	429.3	448.0	466.9	486.0	505.3	524.8	544.5	564.4	584.5	604.8
450	224.9	241.5	258.3	275.3	292.5	309.9	327.5	345.3	363.3	381.5	399.9	418.5	437.3	456.3	475.5	494.9	514.5	534.3	554.3	574.5	594.9
460	212.7	229.4	246.3	263.4	280.7	298.2	315.9	333.8	351.9	370.2	388.7	407.4	426.3	445.4	464.7	484.2	503.9	523.8	543.9	564.2	584.7
470	200.1	216.9	233.9	251.1	268.5	286.1	303.9	321.9	340.1	358.5	377.1	395.9	414.9	434.1	453.5	473.1	492.9	512.9	533.1	553.5	574.1
480	187.1	204.0	221.1	238.4	255.9	273.6	291.5	309.6	327.9	346.4	365.1	384.0	403.1	422.4	441.9	461.6	481.5	501.6	521.9	542.4	563.1
490	173.7	190.7	207.9	225.3	242.9	260.7	278.7	296.9	315.3	333.9	352.7	371.7	390.9	410.3	429.9	449.7	469.7	489.9	510.3	530.9	551.7
500	159.9	177.0	194.3	211.8	229.5	247.4	265.5	283.8	302.3	321.0	339.9	359.0	378.3	397.8	417.5	437.4	457.5	477.8	498.3	519.0	539.9
510	145.7	162.9	180.3	197.9	215.7	233.7	251.9	270.3	288.9	307.7	326.7	345.9	365.3	384.9	404.7	424.7	444.9	465.3	485.9	506.7	527.7
520	131.1	148.4	165.9	183.6	201.5	219.6	237.9	256.4	275.1	294.0	313.1	332.4	351.9	371.6	391.5	411.6	431.9	452.4	473.1	494.0	515.1
530	116.1	133.5	151.1	168.9	186.9	205.1	223.5	242.1	260.9	279.9	299.1	318.5	338.1	357.9	377.9	398.1	418.5	439.1	459.9	480.9	502.1
540	100.6	118.1	135.8	153.7	171.8	190.1	208.6	227.3	246.2	265.3	284.6	304.1	323.8	343.7	363.8	384.1	404.6	425.3	446.2	467.3	488.6
550	84.8	102.4	120.2	138.2	156.4	174.8	193.4	212.2	231.2	250.4	269.8	289.4	309.2	329.2	349.4	369.8	390.4	411.2	432.2	453.4	474.8
560	68.6	86.3	104.2	122.3	140 6	159.1	177.8	196.7	215.8	235.1	254.6	274.3	294.2	314.3	334.6	355.1	375.8	396.7	417.8	439.1	460.6
570	52.0	69.8	87.8	106.0	124.4	143.0	161.8	180.8	200.0	219.4	239.0	258.8	278.8	299.0	319.4	340.0	360.8	381.8	403.0	424.4	446.0
580	35.0	52.9	71.0	89.3	107.8	126.5	145.4	164.5	183.8	203.3	223.0	242.9	263.0	283.3	303.8	324.5	345.4	366.5	387.8	409.3	431.0
590	17.5	35.5	53.7	72.1	90.7	109.5	128.5	147.7	167.1	186.7	206.5	226.5	246.7	267.1	287.7	308.5	329.5	350.7	372.1	393.7	415.5
600	0.0	17.8	36.1	54.6	73.3	92.2	111.3	130.6	150.1	169.8	189.7	209.8	230.1	250.6	271.3	292.2	313.3	334.6	356.1	377.8	399.7

	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
410	631 8	652.0	672.4	693.0	713.8	734.8	756.0	777.4	799.0	820.8	842.8	865.0	887.4	910.0	932.8	955.8	979.0	1002.4	1026.0	1049.8	1073.8
420	623.2	643.5	664.0	684.7	705.6	726.7	748.0	769.5	791.2	813.1	835.2	857.5	880.0	902.7	925.6	948.7	972.0	995.5	1019.2	1043.1	1067.2
430	614.2	634.6	655.2	676.0	697.0	718.2	739.6	761.2	783.0	805.0	827.2	849.6	872.2	895.0	918.0	941.2	964.6	988.2	1012.0	1036.0	1060.2
440	604.8	625.3	646.0	666.9	688.0	709.3	730.8	752.5	774.4	796.5	818.8	841.3	864.0	886.9	910.0	933.3	956.8	980.5	1004.4	1028.5	1052.8
450	594.9	615.5	636.3	657.3	678.5	699.9	721.5	743.3	765.3	787.5	809.9	832.5	855.3	878.3	901.5	924.9	948.5	972.3	996.3	1020.5	1044.9
460	584.7	605.4	626.3	647.4	668.7	690.2	711.9	733.8	755.9	778.2	800.7	823.4	846.3	869.4	892.7	916.2	939.9	963.8	987.9	1012.2	1036.7
470	574.1	594.9	615.9	637.1	658.5	680.1	701.9	723.9	746.1	768.5	791.1	813.9	836.9	860.1	883.5	907.1	930.9	954.9	979.1	1003.5	1028.1
480	563.1	584.0	605.1	626.4	647.9	669.6	691.5	713.6	735.9	758.4	781.1	804.0	827.1	850.4	873.9	897.6	921.5	945.6	969.9	994.4	1019.1
490	551.7	572.7	593.9	615.3	636.9	658.7	680.7	702.9	725.3	747.9	770.7	793.7	816.9	840.3	863.9	887.7	911.7	935.9	960.3	984.9	1009.7
500	539.9	561.0	582.3	603.8	625.5	647.4	669.5	691.8	714.3	737.0	759.9	783.0	806.3	829.8	853.5	877.4	901.5	925.8	950.3	975.0	999.9
510	527.7	548.9	570.3	591.9	613.7	635.7	657.9	680.3	702.9	725.7	748.7	771.9	795.3	818.9	842.7	866.7	890.9	915.3	939.9	964.7	989.7
520	515.1	536.4	557.9	579.6	601.5	623.6	645.9	668.4	691.1	714.0	737.1	760.4	783.9	807.6	831.5	855.6	879.9	904.4	929.1	954.0	979.1
530	502.1	523.5	545.1	566.9	588.9	611.1	633.5	656.1	678.9	701.9	725.1	748.5	772.1	795.9	819.9	844.1	868.5	893.1	917.9	942.9	968.1
540	488.6	510.1	531.8	553.7	575.8	598.1	620.6	643.3	666.2	689.3	712.6	736.1	759.8	783.7	807.8	832.1	856.6	881.3	906.2	931.3	956.6
550	474.8	496.4	518.2	540.2	562.4	584.8	607.4	630.2	653.2	676.4	699.8	723.4	747.2	771.2	795.4	819.8	844.4	869.2	894.2	919.4	944.8
560	460.6	482.3	504.2	526.3	548.6	571.1	593.8	616.7	639.8	663.1	686.6	710.3	734.2	758.3	782.6	807.1	831.8	856.7	881.8	907.1	932.6
570	446.0	467.8	489.8	512.0	534.4	557.0	579.8	602.8	626.0	649.4	673.0	696.8	720.8	745.0	769.4	794.0	818.8	843.8	869.0	894.4	920.0
580	431.0	452.9	475.0	497.3	519.8	542.5	565.4	588.5	611.8	635.3	659.0	682.9	707.0	731.3	755.8	780.5	805.4	830.5	855.8	881.3	907.0
590	415.5	437.5	459.7	482.1	504.7	527.5	550.5	573.7	597.1	620.7	644.5	668.5	692.7	717.1	741.7	766.5	791.5	816.7	842.1	867.7	893.5
600	399.7	421.3	444.1	466.6	489.3	512.2	535.3	558.6	582.1	605.8	629.7	653.8	678.1	702.6	727.3	752.2	777.3	802.6	828.1	853.8	879.7

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
610	743.9	737.7	731.3	724.7	717.9	710.9	703.7	696.3	688.7	680.9	672.9	664.7	656.3	647.7	638.9	629.9	620.7	611.3	601.7	591.9	581.9
620	768.4	762.1	755.6	748.9	742.0	734.9	727.6	720.1	712.4	704.5	696.4	688.1	679.6	670.9	662.0	652.9	643.6	634.1	624.4	614.5	604.4
630	793.4	787.0	780.4	773.6	766.6	759.4	752.0	744.4	736.6	728.6	720.4	712.0	703.4	694.6	685.6	676.4	667.0	657.4	647.6	637.6	627.4
640	818.8	812.3	805.6	798.7	791.6	784.3	776.8	769.1	761.2	753.1	744.8	736.3	727.6	718.7	709.6	700.3	690.8	681.1	671.2	661.1	650.8
650	844.5	837.9	831.1	824.1	816.9	809.5	801.9	794.1	786.1	777.9	769.5	760.9	752.1	743.1	733.9	724.5	714.9	705.1	695.1	684.9	674.5
660	870.7	864.0	857.1	850.0	842.7	835.2	827.5	819.6	811.5	803.2	794.7	786.0	777.1	768.0	758.7	749.2	739.5	729.6	719.5	709.2	698.7
670	897.2	890.4	883.4	876.2	868.8	861.2	853.4	845.4	837.2	828.8	820.2	811.4	802.4	793.2	783.8	774.2	764.4	754.4	744.2	733.8	723.2
680	924.2	917.3	910.2	902.9	895.4	887.7	879.8	871.7	863.4	854.9	846.2	837.3	828.2	818.9	809.4	799.7	789.8	779.7	769.4	758.9	748.2
690	951.5	944.5	937.3	929.9	922.3	914.5	906.5	898.3	889.9	881.3	872.5	863.5	854.3	844.9	835.3	825.5	815.5	805.3	794.9	784.3	773.5
700	979.2	972.1	964.8	957.3	949.6	941.7	933.6	925.3	916.8	908.1	899.2	890.1	880.8	871.3	861.6	851.7	841.6	831.3	820.8	810.1	799.2
710	1007.4	1000.2	992.8	985.2	977.4	969.4	961.2	952.8	944.2	935.4	926.4	917.2	907.8	898.2	888.4	878.4	868.2	857.8	847.2	836.4	825.4
720	1035.9	1028.6	1021.1	1013.4	1005.5	997.4	989.1	980.6	971.9	963.0	953.9	944.6	935.1	925.4	915.5	905.4	895.1	884.6	873.9	863.0	851.9
730	1064.8	1057.4	1049.8	1042.0	1034.0	1025.8	1017.4	1008.8	1000.0	991.0	981.8	972.4	962.8	953.0	943.0	932.8	922.4	911.8	901.0	890.0	878.8
740	1094.1	1086.6	1078.9	1071.0	1062.9	1054.6	1046.1	1037.4	1028.5	1019.4	1010.1	1000.6	990.9	981.0	970.9	960.6	950.1	939.4	928.5	917.4	906.1
750	1123.8	1116.2	1108.4	1100.4	1092.2	1083.8	1075.2	1066.4	1057.4	1048.2	1038.8	1029.2	1019.4	1009.4	999.2	988.8	978.2	967.4	956.4	945.2	933.8
760	1153.9	1146.2	1138.3	1130.2	1121.9	1113.4	1104.7	1095.8	1086.7	1077.4	1067.9	1058.2	1048.3	1038.2	1027.9	1017.4	1006.7	995.8	984.7	973.4	961.9
770	1184.4	1176.6	1168.6	1160.4	1152.0	1143.4	1134.6	1125.6	1116.4	1107.0	1097.4	1087.6	1077.6	1067.4	1057.0	1046.4	1035.6	1024.6	1013.4	1002.0	990.4
780	1215.3	1207.4	1199.3	1191.0	1182.5	1173.8	1164.9	1155.8	1146.5	1137.0	1127.3	1117.4	1107.3	1097.0	1086.5	1075.8	1064.9	1053.8	1042.5	1031.0	1019.3
790	1246.6	1238.6	1230.4	1222.0	1213.4	1204.6	1195.6	1186.4	1177.0	1167.4	1157.6	1147.6	1137.4	1127.0	1116.4	1105.6	1094.6	1083.4	1072.0	1060.4	1048.6
800	1278.3	1270.2	1261.9	1253.4	1244.7	1235.8	1226.7	1217.4	1207.9	1198.2	1188.3	1178.2	1167.9	1157.4	1146.7	1135.8	1124.7	1113.4	1101.9	1090.2	1078.3

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
610	581.9	571.7	561.3	550.7	539.9	528.9	517.7	506.3	494.7	482.9	470.9	458.7	446.3	433.7	420.9	407.9	394.7	381.3	367.7	353.9	339.9
620	604.4	594.1	583.6	572.9	562.0	550.9	539.6	528.1	516.4	504.5	492.4	480.1	467.6	454.9	442.0	428.9	415.6	402.1	388.4	374.5	360.4
630	627.4	617.0	606.4	595.6	584.6	573.4	562.0	550.4	538.6	526.6	514.4	502.0	489.4	476.6	463.6	450.4	437.0	423.4	409.6	395.6	381.4
640	650.8	640.3	629.6	618.7	607.6	596.3	584.8	573.1	561.2	549.1	536.8	524.3	511.6	498.7	485.6	472.3	458.8	445.1	431.2	417.1	402.8
650	674.5	663.9	653.1	642.1	630.9	619.5	607.9	596.1	584.1	571.9	559.5	546.9	534.1	521.1	507.9	494.5	480.9	467.1	453.1	438.9	424.5
660	698.7	688.0	677.1	666.0	654.7	643.2	631.5	619.6	607.5	595.2	582.7	570.0	557.1	544.0	530.7	517.2	503.5	489.6	475.5	461.2	446.7
670	723.2	712.4	701.4	690.2	678.8	667.2	655.4	643.4	631.2	618.8	606.2	593.4	580.4	567.2	553.8	540.2	526.4	512.4	498.2	483.8	469.2
680	748.2	737.2	726.2	714.9	703.4	691.7	679.8	667.7	655.4	642.9	630.2	617.3	604.2	590.9	577.4	563.7	549.8	535.7	521.4	506.9	492.2
690	773.5	762.5	751.3	739.9	728.3	716.5	704.5	692.3	679.9	667.3	654.5	641.5	628.3	614.9	601.3	587.5	573.5	559.3	544.9	530.3	515.5
700	799.2	788.1	776.8	765.3	753.6	741.7	729.6	717.3	704.8	692.1	679.2	666.1	652.8	639.3	625.6	611.7	597.6	583.3	568.8	554.1	539.2
710	825.4	814.2	802.8	791.2	779.4	767.4	755.2	742.8	730.2	717.4	704.4	691.2	677.8	664.2	650.4	636.4	622.2	607.8	593.2	578.4	563.4
720	851.9	840.6	829.1	817.4	805.5	793.4	781.1	768.6	755.9	743.0	729.9	716.6	703.1	689.4	675.5	661.4	647.1	632.6	617.9	603.0	587.9
730	878.8	867.4	855.8	844.0	832.0	819.8	807.4	794.8	782.0	769.0	755.8	742.4	728.8	715.0	701.0	686.8	672.4	657.8	643.0	628.0	612.8
740	906.1	894.6	882.9	871.0	858.9	846.6	834.1	821.4	808.5	795.4	782.1	768.6	754.9	741.0	726.9	712.6	698.1	683.4	668.5	653.4	638.1
750	933.8	922.2	910.4	898.4	886.2	873.8	861.2	848.4	835.4	822.2	808.8	795.2	781.4	767.4	753.2	738.8	724.2	709.4	694.4	679.2	663.8
760	961.9	950.2	938.3	926.2	913.9	901.4	888.7	875.8	862.7	849.4	835.9	822.2	808.3	794.2	779.9	765.4	750.7	735.8	720.7	705.4	689.9
770	990.4	978.6	966.6	954.4	942.0	929.4	916.6	903.6	890.4	877.0	863.4	849.6	835.6	821.4	807.0	792.4	777.6	762.6	747.4	732.0	716.4
780	1019.3	1007.4	995.3	983.0	970.5	957.8	944.9	931.8	918.5	905.0	891.3	877.4	863.3	849.0	834.5	819.8	804.9	789.8	774.5	759.0	743.3
790	1048.6	1036.6	1024.4	1012.0	999.4	986.6	973.6	960.4	947.0	933.4	919.6	905.6	891.4	877.0	862.4	847.6	832.6	817.4	802.0	786.4	770.6
800	1078.3	1066.2	1053.9	1041.4	1028.7	1015.8	1002.7	989.4	975.9	962.2	948.3	934.2	919.9	905.4	890.7	875.8	860.7	845.4	829.9	814.2	798.3

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
610	339.9	325.7	311.3	296.7	281.9	266.9	251.7	236.3	220.7	204.9	188.9	172.7	156.3	139.7	122.9	105.9	88.7	71.3	53.7	35.9	17.9
620	360.4	346.1	331.6	316.9	302.0	286.9	271.6	256.1	240.4	224.5	208.4	192.1	175.6	158.9	142.0	124.9	107.6	90.1	72.4	54.5	36.4
630	381.4	367.0	352.4	337.6	322.6	307.4	292.0	276.4	260.6	244.6	228.4	212.0	195.4	178.6	161.6	144.4	127.0	109.4	91.6	73.6	55.4
640	402.8	388.3	373.6	358.7	343.6	328.3	312.8	297.1	281.2	265.1	248.8	232.3	215.6	198.7	181.6	164.3	146.8	129.1	111.2	93.1	74.8
650	424.5	409.9	395.1	380.1	364.9	349.5	333.9	318.1	302.1	285.9	269.5	252.9	236.1	219.1	201.9	184.5	166.9	149.1	131.1	112.9	94.5
660	446.7	432.0	417.1	402.0	386.7	371.2	355.5	339.6	323.5	307.2	290.7	274.0	257.1	240.0	222.7	205.2	187.5	169.6	151.5	133.2	114.7
670	469.2	454.4	439.4	424.2	408.8	393.2	377.4	361.4	345.2	328.8	312.2	295.4	278.4	261.2	243.8	226.2	208.4	190.4	172.2	153.8	135.2
680	492.2	477.3	462.2	446.9	431.4	415.7	399.8	383.7	367.4	350.9	334.2	317.3	300.2	282.9	265.4	247.7	229.8	211.7	193.4	174.9	156.2
690	515.5	500.5	485.3	469.9	454.3	438.5	422.5	406.3	389.9	373.3	356.5	339.5	322.3	304.9	287.3	269.5	251.5	233.3	214.9	196.3	177.5
700	539.2	524.1	508.8	493.3	477.6	461.7	445.6	429.3	412.8	396.1	379.2	362.1	344.8	327.3	309.6	291.7	273.6	255.3	236.8	218.1	199.2
710	563.4	548.2	532.8	517.2	501.4	485.4	469.2	452.8	436.2	419.4	402.4	385.2	367.8	350.2	332.4	314.4	296.2	277.8	259.2	240.4	221.4
720	587.9	572.6	557.1	541.4	525.5	509.4	493.1	476.6	459.9	443.0	425.9	408.6	391.1	373.4	355.5	337.4	319.1	300.6	281.9	263.0	243.9
730	612.8	597.4	581.8	566.0	550.0	533.8	517.4	500.8	484.0	467.0	449.8	432.4	414.8	397.0	379.0	360.8	342.4	323.8	305.0	286.0	266.8
740	638.1	622.6	606.9	591.0	574.9	558.6	542.1	525.4	508.5	491.4	474.1	456.6	438.9	421.0	402.9	384.6	366.1	347.4	328.5	309.4	290.1
750	663.8	648.2	632.4	616.4	600.2	583.8	567.2	550.4	533.4	516.2	498.8	481.2	463.4	445.4	427.2	408.8	390.2	371.4	352.4	333.2	313.8
760	689.9	674.2	658.3	642.2	625.9	609.4	592.7	575.8	558.7	541.4	523.9	506.2	488.3	470.2	451.9	433.4	414.7	395.8	376.7	357 4	337.9
770	716.4	700.6	684.6	668.4	652.0	635.4	618.6	601.6	584.4	567.0	549.4	531.6	513.6	495.4	477.0	458.4	439.6	420.6	401.4	382.0	362.4
780	743.3	727.4	711.3	695.0	678.5	661.8	644.9	627.8	610.5	593.0	575.3	557.4	539.3	521.0	502.5	483.8	464.9	445.8	426.5	407.0	387.3
790	770.6	754.6	738.4	722.0	705.4	688.6	671.6	654.4	637.0	619.4	601.6	583.6	565.4	547.0	528.4	509.6	490.6	471.4	452.0	432.4	412.6
800	798.3	782.2	765.9	749.4	732.7	715.8	698.7	681.4	663.9	646.2	628.3	610.2	591.9	573.4	554.7	535.8	516.7	497.4	477.9	458.2	438.3

DEFLECTION TABLE $a = 1$

	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
610	17.9	0.0	18.1	36.7	55.5	74.5	93.7	113.1	132.7	152.5	172.5	192.7	213.1	233.7	254.5	275.5	296.7	318.1	339.7	361.5	383.5
620	36.4	18.1	0.0	18.3	37.2	56.3	75.6	95.1	114.8	134.7	154.8	175.1	195.6	216.3	237.2	258.3	279.6	301.1	322.8	344.7	366.8
630	55.4	37.0	18.4	0.0	18.6	37.8	57.2	76.8	96.6	116.6	136.8	157.2	177.8	198.6	219.6	240.8	262.2	283.8	305.6	327.6	349.8
640	74.8	56.3	37.6	18.7	0.0	18.9	38.4	58.1	78.0	98.1	118.4	133.9	159.6	180.5	201.6	222.9	244.4	266.1	288.0	310.1	332.4
650	94.5	75.9	57.1	38.1	18.9	0.0	19.1	38.9	58.9	79.1	99.5	120.1	140.9	161.9	183.1	204.5	226.1	247.9	269.9	292.1	314.5
660	114.7	96.0	77.1	58.0	38.7	19.2	0.0	19.4	39.5	59.8	80.3	101.0	121.9	143.0	164.3	185.8	207.5	229.4	251.5	273.8	296.3
670	135.2	116.4	97.4	78.2	58.8	39.2	19.4	0.0	19.6	40.0	60.6	81.4	102.4	123.6	145.0	166.6	188.4	210.4	232.6	255.0	277.6
680	156.2	137.3	118.2	98.9	79.4	59.7	39.8	19.7	0.0	19.9	40.6	61.5	82.6	103.9	125.4	147.1	169.0	191.1	213.4	235.9	258.6
690	177.5	158.5	139.3	119.9	100.3	80.5	60.5	40.3	19.9	0.0	20.1	41.1	62.3	83.7	105.3	127.1	149.1	171.3	193.7	216.3	239.1
700	199.2	180.1	160.8	141.3	121.6	101.7	81.6	61.3	40.8	20.1	0.0	20.3	41.6	63.1	84.8	106.7	128.8	151.1	173.6	196.3	219.2
710	221.4	202.2	182.8	163.2	143.4	123.4	103.2	82.8	62.2	41.4	20.4	0.0	20.6	42.2	64.0	86.0	108.2	130.6	153.2	176.0	199.0
720	243.9	224.6	205.1	185.4	165.5	145.4	125.1	104.6	83.9	63.0	41.9	20.6	0.0	20.8	42.7	64.8	87.1	109.6	132.3	155.2	178.3
730	266.8	247.4	227.8	208.0	188.0	167.8	147.4	126.8	106.0	85.0	63.8	42.4	20.8	0.0	21.0	43.2	65.6	88.2	111.0	134.0	157.2
740	290.1	270.6	250.9	231.0	210.9	190.6	170.1	149.4	128.5	107.4	86.1	64.6	42.9	21.0	0.0	21.2	43.7	66.4	89.3	112.4	135.7
750	313.8	294.2	274.4	254.4	234.2	213.8	193.2	172.4	151.4	130.2	108.8	87.2	65.4	43.4	21.2	0.0	21.4	44.2	67.2	90.4	113.8
760	337.9	318.2	298.3	278.2	257.9	237.4	216.7	195.8	174.7	153.4	131.9	110.2	88.3	66.2	43.9	21.4	0.0	21.6	44.7	68.0	91.5
770	362.4	342.6	322.6	302.4	282.0	261.4	240.6	219.6	198.4	177.0	155.4	133.6	111.6	89.4	67.0	44.4	21.6	0.0	21.8	45.2	68.8
780	387.3	367.4	347.3	327.0	306.5	285.8	264.9	243.8	222.5	201.0	179.3	157.4	135.3	113.0	90.5	67.8	44.9	21.8	0.0	22.0	45.7
790	412.6	392.6	372.4	352.0	331.4	310.6	289.6	268.4	247.0	225.4	203.6	181.6	159.4	137.0	114.4	91.6	68.6	45.4	22.0	0.0	22.2
800	438.3	418.2	397.9	377.4	356.7	335.8	314.7	293.4	271.9	250.2	228.3	206.2	183.9	161.4	138.7	115.8	92.7	69.4	45.9	22.2	0.0

	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
610	383.5	405.7	428.1	450.7	473.5	496.5	519.7	543.1	566.7	590.5	614.5	638.7	663.1	687.7	712.5	737.5	762.7	788.1	813.7	839.5	865.5
620	366.8	389.1	411.6	434.3	457.2	480.3	503.6	527.1	550.8	574.7	598.8	623.1	647.6	672.3	697.2	722.3	747.6	773.1	798.8	824.7	850.8
630	349.8	372.2	394.8	417.6	440.6	463.8	487.2	510.8	534.6	558.6	582.8	607.2	631.8	656.6	681.6	706.8	732.2	757.8	783.6	809.6	835.8
640	332.4	354.9	377.6	400.5	423.6	446.9	470.4	494.1	518.0	542.1	566.4	590.9	615.6	640.5	665.6	690.9	716.4	742.1	768.0	794.1	820.4
650	314.5	337.1	359.9	382.9	406.1	429.5	453.1	476.9	500.9	525.1	549.5	574.1	598.9	623.9	649.1	674.5	700.1	725.9	751.9	778.1	804.5
660	296.3	319.0	341.9	365.0	388.3	411.8	435.5	459.4	483.5	507.8	532.3	557.0	581.9	607.0	632.3	657.8	683.5	709.4	735.5	761.8	788.3
670	277.6	300.4	323.4	346.6	370.0	393.6	417.4	441.4	465.6	490.0	514.6	539.4	564.4	589.6	615.0	640.6	666.4	692.4	718.6	745.0	771.6
680	258.6	281.5	304.6	327.9	351.4	375.1	399.0	423.1	447.4	471.9	496.6	521.5	546.6	571.9	597.4	623.1	649.0	675.1	701.4	727.9	754.6
690	239.1	262.1	285.3	308.7	332.3	356.1	380.1	404.3	428.7	453.3	478.1	503.1	528.3	553.7	579.3	605.1	631.1	657.3	683.7	710.3	737.1
700	219.2	242.3	265.6	289.1	312.8	336.7	360.8	385.1	409.6	434.3	459.2	484.3	509.6	535.1	560.8	586.7	612.8	639.1	665.6	692.3	719.2
710	199.0	222.2	245.6	269.2	293.0	317.0	341.2	365.6	390.2	415.0	440.0	465.2	490.6	516.2	542.0	568.0	594.2	620.6	647.2	674.0	701.0
720	178.3	201.6	225.1	248.8	272.7	296.8	321.1	345.6	370.3	395.2	420.3	445.6	471.1	496.8	522.7	548.8	575.1	601.6	628.3	655.2	682.3
730	157.2	180.6	204.2	228.0	252.0	276.2	300.6	325.2	350.0	375.0	400.2	425.6	451.2	477.0	503.0	529.2	555.6	582.2	609.0	636.0	663.2
740	135.7	159.2	182.9	206.8	230.9	255.2	279.7	304.4	329.3	354.4	379.7	405.2	430.9	456.8	482.9	509.2	535.7	562.4	589.3	616.4	643.7
750	113.8	137.4	161.2	185.2	209.4	233.8	258.4	283.2	308.2	333.4	358.8	384.4	410.2	436.2	462.4	488.8	515.4	542.2	569.2	596.4	623.8
760	91.5	115.2	139.1	163.2	187.5	212.0	236.7	261.6	286.7	312.0	337.5	363.2	389.1	415.2	441.5	468.0	494.7	521.6	548.7	576.0	603.5
770	68.8	92.6	116.6	140.8	165.2	189.8	214.6	239.6	264.8	290.2	315.8	341.6	367.6	393.8	420.2	446.8	473.6	500.6	527.8	555.2	582.8
780	45.7	69.6	93.7	118.0	142.5	167.2	192.1	217.2	242.5	268.0	293.7	319.6	345.7	372.0	398.5	425.2	452.1	479.2	506.5	534.0	561.7
790	22.2	46.2	70.4	94.8	119.4	144.2	169.2	194.4	219.8	245.4	271.2	297.2	323.4	349.8	376.4	403.2	430.2	457.4	484.8	512.4	540.2
800	0.0	22.4	46.7	71.2	95.9	120.8	145.9	171.2	196.7	222.4	248.3	274.4	300.7	327.2	353.9	380.8	407.9	435.2	462.7	490.4	518.3

DEFLECTION TABLE a = 1

	0	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
810	1310.4	1302.2	1293.8	1285.2	1276.4	1267.4	1258.2	1248.8	1239.2	1229.4	1219.4	1209.2	1198.8	1188.2	1177.4	1166.4	1155.2	1143.8	1132.2	1120.4	1108.4
820	1342.8	1334.5	1326.0	1317.3	1308.4	1299.3	1290.0	1280.5	1270.8	1260.9	1250.8	1240.5	1230.0	1219.3	1208.4	1197.3	1186.0	1174.5	1162.8	1150.9	1138.8
830	1375.7	1367.3	1358.7	1349.9	1340.9	1331.7	1322.3	1312.7	1302.9	1292.9	1282.7	1272.3	1261.7	1250.9	1239.9	1228.7	1217.3	1205.7	1193.9	1181.9	1169.7
840	1408.9	1400.4	1391.7	1382.8	1373.7	1364.4	1354.9	1345.2	1335.3	1325.2	1314.9	1304.4	1293.7	1282.8	1271.7	1260.4	1248.9	1237.2	1225.3	1213.2	1200.9
850	1442.5	1433.9	1425.1	1416.1	1406.9	1397.5	1387.9	1378.1	1368.1	1357.9	1347.5	1336.9	1326.1	1315.1	1303.9	1292.5	1280.9	1269.1	1257.1	1244.9	1232.5
860	1476.6	1467.9	1459.0	1449.9	1440.6	1431.1	1421.4	1411.5	1401.4	1391.1	1380.6	1369.9	1359.0	1347.9	1336.6	1325.1	1313.4	1301.5	1289.4	1277.1	1264.6
870	1511.0	1502.2	1493.2	1484.0	1474.6	1465.0	1455.2	1445.2	1435.0	1424.6	1414.0	1403.2	1392.2	1381.0	1369.6	1358.0	1346.2	1334.2	1322.0	1309.6	1297.0
880	1545.8	1536.9	1527.8	1518.5	1509.0	1499.3	1489.4	1479.3	1469.0	1458.5	1447.8	1436.9	1425.8	1414.5	1403.0	1391.3	1379.4	1367.3	1355.0	1342.5	1329.8
890	1581.0	1572.0	1562.8	1553.4	1543.8	1534.0	1524.0	1513.8	1503.4	1492.8	1482.0	1471.0	1459.8	1448.4	1436.8	1425.0	1413.0	1400.8	1388.4	1375.8	1363.0
900	1616.5	1607.4	1598.1	1588.6	1578.9	1569.0	1558.9	1548.6	1538.1	1527.4	1516.5	1505.4	1494.1	1482.6	1470.9	1459.0	1446.9	1434.6	1422.1	1409.4	1396.5
910	1652.5	1643.3	1633.9	1624.3	1614.5	1604.5	1594.3	1583.9	1573.3	1562.5	1551.5	1540.3	1528.9	1517.3	1505.5	1493.5	1481.3	1468.9	1456.3	1443.5	1430.5
920	1688.9	1679.6	1670.1	1660.4	1650.5	1640.4	1630.1	1619.6	1608.9	1598.0	1586.9	1575.6	1564.1	1552.4	1540.5	1528.4	1516.1	1503.6	1490.9	1478.0	1464.9
930	1725.6	1716.2	1706.6	1696.8	1686.8	1676.6	1666.2	1655.6	1644.8	1633.8	1622.6	1611.2	1599.6	1587.8	1575.8	1563.6	1551.2	1538.6	1525.8	1512.8	1499.6
940	1762.7	1753.2	1743.5	1733.6	1723.5	1713.2	1702.7	1692.0	1681.1	1670.0	1658.7	1647.2	1635.5	1623.6	1611.5	1599.2	1586.7	1574.0	1561.1	1548.0	1534.7
950	1800.2	1790.6	1780.8	1770.8	1760.6	1750.2	1739.6	1728.8	1717.8	1706.6	1695.2	1683.6	1671.8	1659.8	1647.6	1635.2	1622.6	1609.8	1596.8	1583.6	1570.2
960	1838.1	1828.4	1818.5	1808.4	1798.1	1787.6	1776.9	1766.0	1754.9	1743.6	1732.1	1720.4	1708.5	1696.4	1684.1	1671.6	1658.9	1646.0	1632.9	1619.6	1606.1
970	1876.4	1866.6	1856.6	1846.4	1836.0	1825.4	1814.6	1803.6	1792.4	1781.0	1769.4	1757.6	1745.6	1733.4	1721.0	1708.4	1695.6	1682.6	1669.4	1656.0	1642.4
980	1915.0	1905.1	1895.0	1884.7	1874.2	1863.5	1852.6	1841.5	1830.2	1818.7	1807.0	1795.1	1783.0	1770.7	1758.2	1745.5	1732.6	1719.5	1706.2	1692.7	1679.0
990	1954.1	1944.1	1933.9	1923.5	1912.9	1902.1	1891.1	1879.9	1868.5	1856.9	1845.1	1833.1	1820.9	1808.5	1795.9	1783.1	1770.1	1756.9	1743.5	1729.9	1716.1
1000	1993.5	1983.4	1973.1	1962.6	1951.9	1941.0	1929.9	1918.6	1907.1	1895.4	1883.5	1871.4	1859.1	1846.6	1833.9	1821.0	1807.9	1794.6	1781.1	1767.4	1753.5

	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400
810	1108.4	1096.2	1083.8	1071.2	1058.4	1045.4	1032.2	1018.8	1005.2	991.4	977.4	963.2	948.8	934.2	919.4	904.4	889.2	873.8	858.2	842.4	826.4
820	1138.8	1126.5	1114.0	1101.3	1088.4	1075.3	1062.0	1048.5	1034.8	1020.9	1006.8	992.5	978.0	963.3	948.4	933.3	918.0	902.5	886.8	870.9	854.8
830	1169.7	1157.3	1144.7	1131.9	1118.9	1105.7	1092.3	1078.7	1064.9	1050.9	1036.7	1022.3	1007.7	992.9	977.9	962.7	947.3	931.7	915.9	899.9	883.7
840	1200.9	1188.4	1175.7	1162.8	1149.7	1136.4	1122.9	1109.2	1095.3	1081.2	1066.9	1052.4	1037.7	1022.8	1007.7	992.4	976.9	961.2	945.3	929.2	912.9
850	1232.5	1219.9	1207.1	1194.1	1180.9	1167.5	1153.9	1140.1	1126.1	1111.9	1097.5	1082.9	1068.1	1053.1	1037.9	1022.5	1006.9	991.1	975.1	958.9	942.5
860	1264.6	1251.9	1239.0	1225.9	1212.6	1199.1	1185.4	1171.5	1157.4	1143.1	1128.6	1113.9	1099.0	1083.9	1068.6	1053.1	1037.4	1021.5	1005.4	989.1	972.6
870	1297.0	1284.2	1271.2	1258.0	1244.6	1231.0	1217.2	1203.2	1189.0	1174.6	1160.0	1145.2	1130.2	1115.0	1099.6	1084.0	1068.2	1052.2	1036.0	1019.6	1003.0
880	1329.8	1316.9	1303.8	1290.5	1277.0	1263.3	1249.4	1235.3	1221.0	1206.5	1191.8	1176.9	1161.8	1146.5	1131.0	1115.3	1099.4	1083.3	1067.0	1050.5	1033.8
890	1363.0	1350.0	1336.8	1323.4	1309.8	1296.0	1282.0	1267.8	1253.4	1238.8	1224.0	1209.0	1193.8	1178.4	1162.8	1147.0	1131.0	1114.8	1098.4	1081.8	1065.0
900	1396.5	1383.4	1370.1	1356.6	1342.9	1329.0	1314.9	1300.6	1286.1	1271.4	1256.5	1241.4	1226.1	1210.6	1194.9	1179.0	1162.9	1146.6	1130.1	1113.4	1096.5
910	1430.5	1417.3	1403.9	1390.3	1376.5	1362.5	1348.3	1333.9	1319.3	1304.5	1289.5	1274.3	1258.9	1243.3	1227.5	1211.5	1195.3	1178.9	1162.3	1145.5	1128.5
920	1464.9	1451.6	1438.1	1424.4	1410.5	1396.4	1382.1	1367.6	1352.9	1338.0	1322.9	1307.6	1292.1	1276.4	1260.5	1244.4	1228.1	1211.6	1194.9	1178.0	1160.9
930	1499.6	1486.2	1472.6	1458.8	1444.8	1430.6	1416.2	1401.6	1386.8	1371.8	1356.6	1341.2	1325.6	1309.8	1293.8	1277.6	1261.2	1244.6	1227.8	1210.8	1193.6
940	1534.7	1521.2	1507.5	1493.6	1479.5	1465.2	1450.7	1436.0	1421.1	1406.0	1390.7	1375.2	1359.5	1343.6	1327.5	1311.2	1294.7	1278.0	1261.1	1244.0	1226.7
950	1570.2	1556.6	1542.8	1528.8	1514.6	1500.2	1485.6	1470.8	1455.8	1440.6	1425.2	1409.6	1393.8	1377.8	1361.6	1345.2	1328.6	1311.8	1294.8	1277.6	1260.2
960	1606.1	1592.4	1578.5	1564.4	1550.1	1535.6	1520.9	1506.0	1490.9	1475.6	1460.1	1444.4	1428.5	1412.4	1396.1	1379.6	1362.9	1346.0	1328.9	1311.6	1294.1
970	1642.4	1628.6	1614.6	1600.4	1586.0	1571.4	1556.6	1541.6	1526.4	1511.0	1495.4	1479.6	1463.6	1447.4	1431.0	1414.4	1397.6	1380.6	1363.4	1346.0	1328.4
980	1679.0	1665.1	1651.0	1636.7	1622.2	1607.5	1592.6	1577.5	1562.2	1546.7	1531.0	1515.1	1499.0	1482.7	1466.2	1449.5	1432.6	1415.5	1398.2	1380.7	1363.0
990	1716.1	1702.1	1687.9	1673.5	1658.9	1644.1	1629.1	1613.9	1598.5	1582.9	1567.1	1551.1	1534.9	1518.5	1501.9	1485.1	1468.1	1450.9	1433.5	1415.9	1398.1
1000	1753.5	1739.4	1725.1	1710.6	1695.9	1681.0	1665.9	1650.6	1635.1	1619.4	1603.5	1587.4	1571.1	1554.6	1537.9	1521.0	1503.9	1486.6	1469.1	1451.4	1433.5

	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
810	826.4	810.2	793.8	777.2	760.4	743.4	726.2	708.8	691.2	673.4	655.4	637.2	618.8	600.2	581.4	562.4	543.2	523.8	504.2	484.4	464.4
820	854.8	838.5	822.0	805.3	788.4	771.3	754.0	736.5	718.8	700.9	682.8	664.5	646.0	627.3	608.4	589.3	570.0	550.5	530.8	510.9	490.8
830	883.7	867.3	857.7	833.9	816.9	799.7	782.3	764.7	746.9	728.9	710.7	692.3	673.7	654.9	635.9	616.7	597.3	577.7	557.9	537.9	517.7
840	912.9	896.4	879.7	862.8	845.7	828.4	810.9	793.2	775.3	757.2	738.9	720.4	701.7	682.8	663.7	644.4	624.9	605.2	585.3	565.2	544.9
850	942.5	925.9	909.1	892.1	874.9	857.5	839.9	822.1	804.1	785.9	767.5	748.9	730.1	711.1	691.9	672.5	652.9	633.1	613.1	592.9	572.5
860	972.6	955.9	939.0	921.9	904.6	887.1	869.4	851.5	833.4	815.1	796.6	777.9	759.0	739.9	720.6	701.1	681.4	661.5	641.4	621.1	600.6
870	1003.0	986.2	969.2	952.0	934.6	917.0	899.2	881.2	863.0	844.6	826.0	807.2	788.2	769.0	749.6	730.0	710.2	690.2	670.0	649.6	629.0
880	1033.8	1016.9	999.8	982.5	965.0	947.3	929.4	911.3	893.0	874.5	855.8	836.9	817.8	798.5	779.0	759.3	739.4	719.3	699.0	678.5	657.8
890	1065.0	1048.0	1030.8	1013.4	995.8	978.0	960.0	941.8	923.4	904.8	886.0	867.0	847.8	828.4	808.8	789.0	769.0	748.8	728.4	707.8	687.0
900	1096.5	1079.4	1062.1	1044.6	1026.9	1009.0	990.9	972.6	954.1	935.4	916.5	897.4	878.1	858.6	838.9	819.0	798.9	778.6	758.1	737.4	716.5
910	1128.5	1111.3	1093.9	1076.3	1058.5	1040.5	1022.3	1003.9	985.3	966.5	947.5	928.3	908.9	889.3	869.5	849.5	829.3	808.9	788.3	767.5	746.5
920	1160.9	1143.6	1126.1	1108.4	1090.5	1072.4	1054.1	1035.6	1016.9	998.0	978.9	959.6	940.1	920.4	900.5	880.4	860.1	839.6	818.9	798.0	776.9
930	1193.6	1176.2	1158.6	1140.8	1122.8	1104.6	1086.2	1067.6	1048.8	1029.8	1010.6	991.2	971.6	951.8	931.8	911.6	891.2	870.6	849.8	828.8	807.6
940	1226.7	1209.2	1191.5	1173.6	1155.5	1137.2	1118.7	1100.0	1081.1	1062.0	1042.7	1023.2	1003.5	983.6	963.5	943.2	922.7	902.0	881.1	860.0	838.7
950	1260.2	1242.6	1224.8	1206.8	1188.6	1170.2	1151.6	1132.8	1113.8	1094.6	1075.2	1055.6	1035.8	1015.8	995.6	975.2	954.6	933.8	912.8	891.6	870.2
960	1294.1	1276.4	1258.5	1240.4	1222.1	1203.6	1184.9	1166.0	1146.9	1127.6	1108.1	1088.4	1068.5	1048.4	1028.1	1007.6	986.9	966.0	944.9	923.6	902.1
970	1328.4	1310.6	1292.6	1274.4	1256.0	1237.4	1218.6	1199.6	1180.4	1161.0	1141.4	1121.6	1101.6	1081.4	1061.0	1040.4	1019.6	998.6	977.4	956.0	934.4
980	1363.0	1345.1	1327.0	1308.7	1290.2	1271.5	1252.6	1233.5	1214.2	1194.7	1175.0	1155.1	1135.0	1114.7	1094.2	1073.5	1052.6	1031.5	1010.2	988.7	967.0
990	1398.1	1380.1	1361.9	1343.5	1324.9	1306.1	1287.1	1267.9	1248.5	1228.9	1209.1	1189.1	1168.9	1148.5	1127.9	1107.1	1086.1	1064.9	1043.5	1021.9	1000.1
1000	1433.5	1415.4	1397.1	1378.6	1359.9	1341.0	1321.9	1302.6	1283.1	1263.4	1243.5	1223.4	1203.1	1182.6	1161.9	1141.0	1119.9	1098.6	1077.1	1055.4	1033.5

	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800
810	464.4	444.2	423.8	403.2	382.4	361.4	340.2	318.8	297.2	275.4	253.4	231.2	208.8	186.2	163.4	140.4	117.2	93.8	70.2	46.4	22.4
820	490.8	470.5	450.0	429.3	408.4	387.3	366.0	344.5	322.8	300.9	278.8	256.5	234.0	211.3	188.4	165.3	142.0	118.5	94.8	70.9	46.8
830	517.7	497.3	476.7	455.9	434.9	413.7	392.3	370.7	348.9	326.9	304.7	282.3	259.7	236.9	213.9	190.7	167.3	143.7	119.9	95.9	71.7
840	544.9	524.4	503.7	482.8	461.7	440.4	418.9	397.2	375.3	353.2	330.9	308.4	285.7	262.8	239.7	216.4	192.9	169.2	145.3	121.2	96.9
850	572.5	551.9	531.1	510.1	488.9	467.5	445.9	424.1	402.1	379.9	357.5	334.9	312.1	289.1	265.9	242.5	218.9	195.1	171.1	146.9	122.5
860	600.6	579.9	559.0	537.9	516.6	495.1	473.4	451.5	429.4	407.1	384.6	361.9	339.0	315.9	292.6	269.1	245.4	221.5	197.4	173.1	148.6
870	629.0	608.2	587.2	566.0	544.6	523.0	501.2	479.2	457.0	434.6	412.0	389.2	366.2	343.0	319.6	296.0	272.2	248.2	224.0	199.6	175.0
880	657.8	636.9	615.8	594.5	573.0	551.3	529.4	507.3	485.0	462.5	439.8	416.9	393.8	370.5	347.0	323.3	299.4	275.3	251.0	226.5	201.8
890	687.0	666.0	644.8	623.4	601.8	580.0	558.0	535.8	513.4	490.8	468.0	445.0	421.8	398.4	374.8	351.0	327.0	302.8	278.4	253.8	229.0
900	716.5	695.4	674.1	652.6	630.9	609.0	586.9	564.6	542.1	519.4	496.5	473.4	450.1	426.6	402.9	379.0	354.9	330.6	306.1	281.4	256.5
910	746.5	725.3	703.9	682.3	660.5	638.5	616.3	593.9	571.3	548.5	525.5	502.3	478.9	455.3	431.5	407.5	383.3	358.9	334.3	309.5	284.5
920	776.9	755.6	734.1	712.4	690.5	668.4	646.1	623.6	600.9	578.0	554.9	531.6	508.1	484.4	460.5	436.4	412.1	387.6	362.9	338.0	312.9
930	807.6	786.2	764.6	742.8	720.8	698.6	676.2	653.6	630.8	607.8	584.6	561.2	537.6	513.8	489.8	465.6	441.2	416.6	391.8	366.8	341.6
940	838.7	817.2	795.5	773.6	751.5	729.2	706.7	684.0	661.1	638.0	614.7	591.2	567.5	543.6	519.5	495.2	470.7	446.0	421.1	396.0	370.7
950	870.2	848.6	826.8	804.8	782.6	760.2	737.6	714.8	691.8	668.6	645.2	621.6	597.8	573.8	549.6	525.2	500.6	475.8	450.8	425.6	400.2
960	902.1	880.4	858.5	836.4	814.1	791.6	768.9	746.0	722.9	699.6	676.1	652.4	628.5	604.4	580.1	555.6	530.9	506.0	480.9	455.6	430.1
970	934.4	912.6	890.6	868.4	846.0	823.4	800.6	777.6	754.4	731.0	707.4	683.6	659.6	635.4	611.0	586.4	561.6	536.6	511.4	486.0	460.4
980	967.0	945.1	923.0	900.7	878.2	855.5	832.6	809.5	786.2	762.7	739.0	715.1	691.0	666.7	642.2	617.5	592.6	567.5	542.2	516.7	491.0
990	1001.1	978.1	955.9	933.5	910.9	888.1	865.1	841.9	818.5	794.9	771.1	747.1	722.9	698.5	673.9	649.1	624.1	598.9	573.5	547.9	522.1
1000	1033.5.	1011.4	989.1	966.6	943.9	921.0	897.9	874.6	851.1	827.4	803.5	779.4	755.1	730.6	705.9	681.0	655.9	630.6	605.1	579.4	553.5

DEFLECTION TABLE

a = 1

	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000
810	22.4	0.0	22.6	47.2	72.0	97.0	122.2	147.6	173.2	199.0	225.0	251.2	277.6	304.2	331.0	358.0	385.2	412.6	440.2	468.0	496.0
820	46.8	22.5	0.0	22.7	47.6	72.7	98.0	123.5	149.2	175.1	201.2	227.5	254.0	280.7	307.6	334.7	362.0	389.5	417.2	445.1	473.2
830	71.7	47.3	22.7	0.0	22.9	48.1	73.5	99.1	124.9	150.9	177.1	203.5	230.1	256.9	283.9	311.1	338.5	366.1	393.9	421.9	450.1
840	96.9	72.4	47.7	22.8	0.0	23.0	48.5	74.2	100.1	126.2	152.5	179.0	205.7	232.6	259.7	287.0	314.5	342.2	370.1	398.2	426.5
850	122.5	97.9	73.1	48.1	22.9	0.0	23.1	48.9	74.9	101.1	127.5	154.1	180.9	207.9	235.1	262.5	290.1	317.9	345.9	374.1	402.5
860	148.6	123.9	99.0	73.9	48.6	23.1	0.0	23.3	49.4	75.7	102.2	128.9	155.8	182.9	210.2	237.7	265.4	293.3	321.4	349.7	378.2
870	175.0	150.2	125.2	100.0	74.6	49.0	23.2	0.0	23.4	49.8	76.4	103.2	130.2	157.4	184.8	212.4	240.2	268.2	296.4	324.8	353.4
880	201.8	176.9	151.8	126.5	101.0	75.3	49.4	23.3	0.0	23.5	50.2	77.1	104.2	131.5	159.0	186.7	214.6	242.7	271.0	299.5	328.2
890	229.0	204.0	178.8	153.4	127.8	102.0	76.0	49.8	23.4	0.0	23.6	50.6	77.8	105.2	132.8	160.6	188.6	216.8	245.2	273.8	302.6
900	256.5	231.4	206.1	180.6	154.9	129.0	102.9	76.6	50.1	23.4	0.0	23.6	50.9	78.4	106.1	134.0	162.1	190.4	218.9	247.6	276.5
910	284.5	259.3	233.9	208.3	182.5	156.5	130.3	103.9	77.3	50.5	23.5	0.0	23.7	51.3	79.1	107.1	135.3	163.7	192.3	221.1	250.1
920	312.9	287.6	262.1	236.4	210.5	184.4	158.1	131.6	104.9	78.0	50.9	23.6	0.0	23.8	51.7	79.8	108.1	136.6	165.3	194.2	223.3
930	341.6	316.2	290.6	264.8	238.8	212.6	186.2	159.6	132.8	105.8	78.6	51.2	23.6	0.0	23.8	52.0	80.4	109.0	137.8	166.8	196.0
940	370.7	345.2	319.5	293.6	267.5	241.2	214.7	188.0	161.1	134.0	106.7	79.2	51.5	23.6	0.0	23.8	52.3	81.0	109.9	139.0	168.3
950	400.2	374.6	348.8	322.8	296.6	270.2	243.6	216.8	189.8	162.6	135.2	107.6	79.8	51.8	23.6	0.0	23.8	52.6	81.6	110.8	140.2
960	430.1	404.4	378.5	352.4	326.1	299.6	272.9	246.0	218.9	191.6	164.1	136.4	108.5	80.4	52.1	23.6	0.0	23.8	52.9	82.2	111.7
970	460.4	434.6	408.6	382.4	356.0	329.4	302.6	275.6	248.4	221.0	193.4	165.6	137.6	109.4	81.0	52.4	23.6	0.0	23.8	53.2	82.8
980	491.0	465.1	439.0	412.7	386.2	359.5	332.6	305.5	278.2	250.7	223.0	195.1	167.0	138.7	110.2	81.5	52.6	23.5	0.0	23.7	53.4
990	522.1	496.1	469.9	443.5	416.9	390.1	363.1	335.9	308.5	280.9	253.1	225.1	196.9	168.5	139.9	111.1	82.1	52.9	23.5	0.0	23.7
1000	553.5	527.4	501.1	474.6	447.9	421.0	393.9	366.6	339.1	311.4	283.5	255.4	227.1	198.6	169.9	141.0	111.9	82.6	53.1	23.4	0.0

TABLE IV

Coefficients of function of Standard Highway Spiral.

To obtain values of any of the functions listed multiply the coefficient by the length of the spiral.

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
0°01′	0°00′20″	1.000000	1.000000	0.000097
0°02′	0°00′40″	1.000000	1.000000	0.000194
0°03′	0°01′00″	1.000000	1.000000	0.000291
0°04′	0°01′20″	1.000000	1.000000	0.000388
0°05′	0°01′40″	1.000000	1.000000	0.000485
0°06′	0°02′00″	1.000000	1.000000	0.000582
0°07′	0°02′20″	1.000000	1.000000	0.000679
0°08′	0°02′40″	1.000000	0.999999	0.000776
0°09′	0°03′00″	1.000000	0.999999	0.000873
0°10′	0°03′20″	1.000000	0.999999	0.000970
0°11′	0°03′40″	1.000000	0.999999	0.001067
0°12′	0°04′00″	0.999999	0.999999	0.001164
0°13′	0°04′20″	0.999999	0.999999	0.001261
0°14′	0°04′40″	0.999999	0.999998	0.001357
0°15′	0°05′00″	0.999999	0.999998	0.001454
0°16′	0°05′20″	0.999999	0.999998	0.001551
0°17′	0°05′40″	0.999999	0.999998	0.001648
0°18′	0°06′00″	0.999999	0.999997	0.001745
0°19′	0°06′20″	0.999999	0.999997	0.001842
0°20′	0°06′40″	0.999998	0.999997	0.001939
0°21′	0°07′00″	0.999998	0.999996	0.002036
0°22′	0°07′20″	0.999998	0.999996	0.002133
0°23′	0°07′40″	0.999998	0.999996	0.002230
0°24′	0°08′00″	0.999998	0.999995	0.002327
0°25′	0°08′20″	0.999998	0.999995	0.002424
0°26′	0°08′40″	0.999997	0.999994	0.002521
0°27′	0°09′00″	0.999997	0.999994	0.002618
0°28′	0°09′20″	0.999997	0.999993	0.002715
0°29′	0°09′40″	0.999997	0.999993	0.002812
0°30′	0°10′00″	0.999997	0.999992	0.002909
0°31′	0°10′20″	0.999996	0.999992	0.003006
0°32′	0°10′40″	0.999996	0.999991	0.003103
0°33′	0°11′00″	0.999996	0.999991	0.003200
0°34′	0°11′20″	0.999996	0.999990	0.003297
0°36′	0°12′00″	0.999995	0.999989	0.003491
0°37′	0°12′20″	0.999995	0.999988	0.003588
0°38′	0°12′40″	0.999995	0.999988	0.003685
0°39′	0°13′00″	0.999994	0.999987	0.003781
0°40′	0°13′20″	0.999994	0.999986	0.003878
0°41′	0°13′40″	0.999994	0.999986	0.003975
0°42′	0°14′00″	0.999993	0.999985	0.004072
0°43′	0°14′20″	0.999993	0.999984	0.004169
0°44′	0°14′40″	0.999993	0.999984	0.004266
0°45′	0°15′00″	0.999992	0.999983	0.004363
0°46′	0°15′20″	0.999992	0.999982	0.004460
0°47′	0°15′40″	0.999992	0.999981	0.004557
0°48′	0°16′00″	0.999991	0.999981	0.004654
0°49′	0°16′20″	0.999991	0.999980	0.004751
0°50′	0°16′40″	0.999991	0.999979	0.004848
0°51′	0°17′00″	0.999990	0.999978	0.004945
0°52′	0°17′20″	0.999990	0.999977	0.005042
0°53′	0°17′40″	0.999989	0.999976	0.005139
0°54′	0°18′00″	0.999989	0.999975	0.005236

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666667	0.333333	0.000011	0.500000	0°01′
0.666667	0.333333	0.000048	0.500000	0°02′
0.666667	0.333333	0.000067	0.500000	0°03′
0.666667	0.333333	0.000091	0.500000	0°04′
0.666667	0.333333	0.000117	0.500000	0°05′
0.666667	0.333333	0.000143	0.500000	0°06′
0.666667	0.333333	0.000160	0.500000	0°07′
0.666667	0.333334	0.000191	0.500000	0°08′
0.666667	0.333334	0.000216	0.500000	0°09′
0.666667	0.333334	0.000241	0.500000	0°10′
0.666667	0.333334	0.000267	0.500000	0°11′
0.666667	0.333334	0.000290	0.500000	0°12′
0.666667	0.333334	0.000314	0.500000	0°13′
0.666667	0.333334	0.000338	0.500000	0°14′
0.666667	0.333334	0.000362	0.500000	0°15′
0.666667	0.333334	0.000387	0.500000	0°16′
0.666667	0.333334	0.000411	0.500000	0°17′
0.666667	0.333334	0.000436	0.500000	0°18′
0.666667	0.333335	0.000460	0.500000	0°19′
0.666668	0.333335	0.000484	0.500000	0°20′
0.666668	0.333335	0.000509	0.500000	0°21′
0.666668	0.333335	0.000533	0.500000	0°22′
0.666668	0.333335	0.000558	0.500000	0°23′
0.666668	0.333335	0.000581	0.500000	0°24′
0.666668	0.333335	0.000605	0.499999	0°25′
0.666669	0.333335	0.000630	0.499999	0°26′
0.666669	0.333335	0.000654	0.499999	0°27′
0.666669	0.333336	0.000679	0.499999	0°28′
0.666669	0.333336	0.000702	0.499999	0°29′
0.666669	0.333336	0.000726	0.499999	0°30′
0.666669	0.333336	0.000751	0.499999	0°31′
0.666670	0.333336	0.000775	0.499999	0°32′
0.666670	0.333336	0.000800	0.499999	0°33′
0.666670	0.333336	0.000824	0.499998	0°34′
0.666670	0.333337	0.000872	0.499998	0°36′
0.666671	0.333337	0.000897	0.499998	0°37′
0.666671	0.333337	0.000921	0.499998	0°38′
0.666671	0.333337	0.000945	0.499998	0°39′
0.666671	0.333338	0.000969	0.499998	0°40′
0.666672	0.333338	0.000994	0.499998	0°41′
0.666672	0.333338	0.001018	0.499998	0°42′
0.666672	0.333338	0.001042	0.499998	0°43′
0.666672	0.333339	0.001066	0.499998	0°44′
0.666673	0.333339	0.001091	0.499997	0°45′
0.666673	0.333339	0.001115	0.499997	0°46′
0.666673	0.333339	0.001139	0.499997	0°47′
0.666673	0.333340	0.001163	0.499997	0°48′
0.666674	0.333340	0.001188	0.499997	0°49′
0.666674	0.333340	0.001212	0.499997	0°50′
0.666674	0.333340	0.001236	0.499996	0°51′
0.666675	0.333341	0.001260	0.499996	0°52′
0.666675	0.333341	0.001284	0.499996	0°53′
0.666675	0.333341	0.001309	0.499996	0°54′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
0°55′	0°18′20″	0.999989	0.999974	0.005333
0°56′	0°18′40″	0.999988	0.999973	0.005430
0°57′	0°19′00″	0.999988	0.999973	0.005527
0°58′	0°19′20″	0.999987	0.999972	0.005624
0°59′	0°19′40″	0.999987	0.999971	0.005721
1°00′	0°20′00″	0.999986	0.999970	0.005818
1°01′	0°20′20″	0.999986	0.999969	0.005915
1°02′	0°20′40″	0.999986	0.999967	0.006012
1°03′	0°21′00″	0.999985	0.999966	0.006109
1°04′	0°21′20″	0.999985	0.999965	0.006205
1°05′	0°21′40″	0.999984	0.999964	0.006302
1°06′	0°22′00″	0.999984	0.999963	0.006399
1°07′	0°22′20″	0.999983	0.999962	0.006496
1°08′	0°22′40″	0.999983	0.999961	0.006593
1°09′	0°23′00″	0.999982	0.999960	0.006690
1°10′	0°23′20″	0.999982	0.999959	0.006787
1°11′	0°23′40″	0.999981	0.999957	0.006884
1°12′	0°24′00″	0.999980	0.999956	0.006981
1°13′	0°24′20″	0.999980	0.999955	0.007078
1°14′	0°24′40″	0.999979	0.999954	0.007175
1°15′	0°25′00″	0.999979	0.999952	0.007272
1°16′	0°25′00″	0.999978	0.999951	0.007369
1°17′	0°25′40″	0.999978	0.999950	0.007466
1°18′	0°26′00″	0.999977	0.999949	0.007563
1°19′	0°26′20″	0.999977	0.999947	0.007660
1°20′	0°26′40″	0.999976	0.999946	0.007757
1°21′	0°27′00″	0.999975	0.999944	0.007854
1°22′	0°27′20″	0.999975	0.999943	0.007951
1°23′	0°27′40″	0.999974	0.999942	0.008048
1°24	0°28′00″	0.999973	0.999940	0.008145
1°25′	0°28′20″	0.999973	0.999939	0.008241
1°26′	0°28′40″	0.999972	0.999937	0.008338
1°27′	0°29′00″	0.999972	0.999936	0.008435
1°28′	0°29′20″	0.999971	0.999934	0.008532
1°29′	0°29′40″	0.999970	0.999933	0.008629
1°30′	0°30′00″	0.999970	0.999931	0.008726
1°31′	0°30′20″	0.999969	0.999930	0.008823
1°32′	0°30′40″	0.999968	0.999928	0.008920
1°33′	0°31′00″	0.999967	0.999927	0.009017
1°34′	0°31′20″	0.999967	0.999925	0.009114
1°35′	0°31′40″	0.999966	0.999924	0.009211
1°36′	0°32′00″	0.999965	0.999922	0.009308
1°37′	0°32′20″	0.999965	0.999920	0.009405
1°38′	0°32′40″	0.999964	0.999919	0.009502
1°39′	0°33′00″	0.999963	0.999917	0.009599
1°40′	0°33′20″	0.999962	0.999915	0.009696
1°41′	0°33′40″	0.999962	0.999914	0.009793
1°42′	0°34′00″	0.999961	0.999912	0.009890
1°43′	0°34′20″	0.999960	0.999910	0.009987
1°44′	0°34′40″	0.999959	0.999908	0.010083
1°45′	0°35′00″	0.999959	0.999907	0.010180
1°46′	0°35′20″	0.999958	0.999905	0.010277
1°47′	0°35′40″	0.999957	0.999903	0.010374

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666676	0.333341	0.001333	0.499996	0°55′
0.666676	0.333342	0.001357	0.499996	0°56′
0.666676	0.333342	0.001382	0.499996	0°57′
0.666677	0.333342	0.001406	0.499995	0°58′
0.666677	0.333343	0.001430	0.499995	0°59′
0.666677	0.333343	0.001454	0.499995	1°00′
0.666678	0.333343	0.001478	0.499995	1°01′
0.666678	0.333344	0.001503	0.499995	1°02′
0.666678	0.333344	0.001527	0.499995	1°03′
0.666679	0.333344	0.001551	0.499994	1°04′
0.666679	0.333345	0.001576	0.499994	1°05′
0.666680	0.333345	0.001600	0.499994	1°06′
0.666680	0.333345	0.001624	0.499994	1°07′
0.666680	0.333346	0.001648	0.499994	1°08′
0.666681	0.333346	0.001672	0.499993	1°09′
0.666681	0.333347	0.001697	0.499993	1°10′
0.666681	0.333347	0.001721	0.499993	1°11′
0.666682	0.333347	0.001745	0.499993	1°12′
0.666682	0.333348	0.001769	0.499993	1°13′
0.666683	0.333348	0.001794	0.499992	1°14′
0.666683	0.333348	0.001818	0.499992	1°15′
0.666684	0.333349	0.001842	0.499992	1°16′
0.666684	0.333349	0.001866	0.499992	1°17′
0.666685	0.333350	0.001891	0.499992	1°18′
0.666685	0.333350	0.001915	0.499991	1°19′
0.666686	0.333351	0.001939	0.499991	1°20′
0.666686	0.333351	0.001963	0.499991	1°21′
0.666686	0.333351	0.001988	0.499991	1°22′
0.666687	0.333352	0.002012	0.499990	1°23′
0.666687	0.333352	0.002036	0.499990	1°24′
0.666688	0.333353	0.002060	0.499990	1°25′
0.666689	0.333353	0.002085	0.499990	1°26′
0.666689	0.333354	0.002109	0.499989	1°27′
0.666690	0.333354	0.002133	0.499989	1°28′
0.666690	0.333355	0.002157	0.499989	1°29′
0.666691	0.333355	0.002181	0.499989	1°30′
0.666691	0.333356	0.002206	0.499988	1°31′
0.666692	0.333356	0.002230	0.499988	1°32′
0.666692	0.333357	0.002254	0.499988	1°33′
0.666693	0.333357	0.002278	0.499988	1°34′
0.666693	0.333358	0.002303	0.499987	1°35′
0.666694	0.333358	0.002327	0.499987	1°36′
0.666694	0.333359	0.002351	0.499987	1°37′
0.666695	0.333359	0.002375	0.499987	1°38′
0.666696	0.333360	0.002400	0.499986	1°39′
0.666696	0.333360	0.002424	0.499986	1°40′
0.666697	0.333361	0.002448	0.499986	1°41′
0.666697	0.333361	0.002472	0.499985	1°42′
0.666698	0.333362	0.002497	0.499985	1°43′
0.666699	0.333362	0.002521	0.499985	1°44′
0.666699	0.333363	0.002545	0.499985	1°45′
0.666700	0.333364	0.002569	0.499984	1°46′
0.666701	0.333364	0.002594	0.499984	1°47′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
1°48′	0°36′00″	0.999956	0.999901	0.010471
1°49′	0°36′20″	0.999955	0.999899	0.010568
1°50′	0°36′40″	0.999954	0.999898	0.010665
1°51′	0°37′00″	0.999954	0.999896	0.010762
1°52′	0°37′20″	0.999953	0.999894	0.010859
1°53′	0°37′40″	0.999952	0.999892	0.010956
1°54′	0°38′00″	0.999951	0.999890	0.011053
1°55′	0°38′20″	0.999950	0.999888	0.011150
1°56′	0°38′40″	0.999949	0.999886	0.011247
1°57′	0°39′00″	0.999949	0.999884	0.011344
1°58′	0°39′20″	0.999948	0.999882	0.011441
1°59′	0°39′40″	0.999947	0.999880	0.011538
2°00′	0°40′00″	0.999946	0.999878	0.011634
2°01′	0°40′20″	0.999945	0.999876	0.011731
2°02′	0°40′40″	0.999944	0.999874	0.011828
2°03′	0°41′00″	0.999943	0.999872	0.011925
2°04′	0°41′20″	0.999942	0.999870	0.012022
2°05′	0°41′40″	0.999941	0.999868	0.012119
2°06′	0°42′00″	0.999940	0.999866	0.012216
2°07′	0°42′20″	0.999939	0.999864	0.012313
2°08′	0°42′40″	0.999938	0.999861	0.012410
2°09′	0°43′00″	0.999937	0.999859	0.012507
2°10′	0°43′20″	0.999936	0.999857	0.012604
2°11′	0°43′40″	0.999935	0.999855	0.012701
2°12′	0°44′00″	0.999934	0.999853	0.012798
2°13′	0°44′20″	0.999933	0.999850	0.012895
2°14′	0°44′40″	0.999932	0.999848	0.012992
2°15′	0°45′00″	0.999931	0.999846	0.013089
2°16′	0°45′20″	0.999930	0.999844	0.013185
2°17′	0°45′40″	0.999929	0.999841	0.013282
2°18′	0°46′00″	0.999928	0.999839	0.013379
2°19′	0°46′20″	0.999927	0.999837	0.013476
2°20′	0°46′40″	0.999926	0.999834	0.013573
2°21′	0°47′00″	0.999925	0.999832	0.013670
2°22′	0°47′20″	0.999924	0.999829	0.013767
2°23′	0°47′40″	0.999923	0.999827	0.013864
2°24′	0°48′00″	0.999922	0.999825	0.013961
2°25′	0°48′20″	0.999921	0.999822	0.014058
2°26′	0°48′40″	0.999920	0.999820	0.014155
2°27′	0°49′00″	0.999919	0.999817	0.014252
2°28′	0°49′20″	0.999918	0.999815	0.014349
2°29′	0°49′40″	0.999917	0.999812	0.014445
2°30′	0°50′00″	0.999915	0.999810	0.014542
2°31′	0°50′20″	0.999914	0.999807	0.014639
2°32′	0°50′40″	0.999913	0.999805	0.014736
2°33′	0°51′00″	0.999912	0.999802	0.014833
2°34′	0°51′20″	0.999911	0.999799	0.014930
2°35′	0°51′40″	0.999910	0.999797	0.015027
2°36′	0°52′00″	0.999908	0.999794	0.015124
2°37′	0°52′20″	0.999907	0.999791	0.015221
2°38′	0°52′40″	0.999906	0.999789	0.015318
2°39′	0°53′00″	0.999905	0.999786	0.015415
2°40′	0°53′20″	0.999904	0.999783	0.015512

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666701	0.333365	0.002618	0.499984	1°48′
0.666702	0.333365	0.002642	0.499983	1°49′
0.666702	0.333366	0.002666	0.499983	1°50′
0.666703	0.333366	0.002690	0.499983	1°51′
0.666704	0.333367	0.002715	0.499982	1°52′
0.666704	0.333368	0.002739	0.499982	1°53′
0.666705	0.333368	0.002763	0.499982	1°54′
0.666706	0.333369	0.002788	0.499981	1°55′
0.666706	0.333369	0.002812	0.499981	1°56′
0.666707	0.333370	0.002836	0.499981	1°57′
0.666708	0.333371	0.002860	0.499980	1°58′
0.666709	0.333371	0.002884	0.499980	1°59′
0.666709	0.333372	0.002909	0.499980	2°00′
0.666710	0.333373	0.002933	0.499979	2°01′
0.666711	0.333373	0.002957	0.499979	2°02′
0.666711	0.333374	0.002981	0.499979	2°03′
0.666712	0.333375	0.003006	0.499978	2°04′
0.666713	0.333375	0.003030	0.499978	2°05′
0.666714	0.333376	0.003054	0.499978	2°06′
0.666714	0.333377	0.003078	0.499977	2°07′
0.666715	0.333377	0.003103	0.499977	2°08′
0.666716	0.333378	0.003127	0.499977	2°09′
0.666717	0.333379	0.003151	0.499976	2°10′
0.666717	0.333379	0.003175	0.499976	2°11′
0.666718	0.333380	0.003200	0.499975	2°12′
0.666719	0.333381	0.003224	0.499975	2°13′
0.666720	0.333382	0.003248	0.499975	2°14′
0.666721	0.333382	0.003272	0.499974	2°15′
0.666721	0.333383	0.003296	0.499974	2°16′
0.666722	0.333384	0.003321	0.499974	2°17′
0.666723	0.333384	0.003345	0.499973	2°18′
0.666724	0.333385	0.003369	0.499973	2°19′
0.666725	0.333386	0.003393	0.499972	2°20′
0.666725	0.333387	0.003418	0.499972	2°21′
0.666726	0.333388	0.003442	0.499972	2°22′
0.666727	0.333388	0.003466	0.499971	2°23′
0.666728	0.333389	0.003490	0.499971	2°24′
0.666729	0.333390	0.003515	0.499970	2°25′
0.666730	0.333391	0.003539	0.499970	2°26′
0.666731	0.333391	0.003563	0.499970	2°27′
0.666731	0.333392	0.003587	0.499969	2°28′
0.666732	0.333393	0.003612	0.499969	2°29′
0.666733	0.333394	0.003636	0.499968	2°30′
0.666734	0.333395	0.003660	0.499968	2°31′
0.666735	0.333395	0.003684	0.499967	2°32′
0.666736	0.333396	0.003708	0.499967	2°33′
0.666737	0.333397	0.003733	0.499967	2°34′
0.666738	0.333398	0.003757	0.499966	2°35′
0.666739	0.333399	0.003781	0.499966	2°36′
0.666740	0.333400	0.003805	0.499965	2°37′
0.666740	0.333400	0.003830	0.499965	2°38′
0.666741	0.333401	0.003854	0.499964	2°39′
0.666742	0.333402	0.003878	0.499964	2°40′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
2°41′	0°53′40″	0.999903	0.999781	0.015609
2°42′	0°54′00″	0.999901	0.999778	0.015705
2°43′	0°54′20″	0.999900	0.999775	0.015802
2°44′	0°54′40″	0.999899	0.999772	0.015899
2°45′	0°55′00″	0.999898	0.999770	0.015996
2°46′	0°55′20″	0.999896	0.999767	0.016093
2°47′	0°55′40″	0.999895	0.999764	0.016190
2°48′	0°56′00″	0.999894	0.999761	0.016287
2°49′	0°56′20″	0.999893	0.999758	0.016384
2°50′	0°56′40″	0.999891	0.999755	0.016481
2°51′	0°57′00″	0.999890	0.999753	0.016578
2°52′	0°57′20″	0.999889	0.999750	0.016675
2°53′	0°57′40″	0.999887	0.999747	0.016771
2°54′	0°58′00″	0.999886	0.999744	0.016868
2°55′	0°58′20″	0.999885	0.999741	0.016965
2°56′	0°58′40″	0.999884	0.999738	0.017062
2°57′	0°59′00″	0.999882	0.999735	0.017159
2°58′	0°59′20″	0.999881	0.999732	0.017256
2°59′	0°59′40″	0.999880	0.999729	0.017353
3°00′	1°00′00″	0.999878	0.999726	0.017450
3°01′	1°00′20″	0.999877	0.999723	0.017547
3°02′	1°00′40″	0.999875	0.999720	0.017644
3°03′	1°01′00″	0.999874	0.999717	0.017741
3°04′	1°01′20″	0.999873	0.999714	0.017837
3°05′	1°01′40″	0.999871	0.999710	0.017934
3°06′	1°02′00″	0.999870	0.999707	0.018031
3°07′	1°02′20″	0.999868	0.999704	0.018128
3°08′	1°02′40″	0.999867	0.999701	0.018225
3°09′	1°03′00″	0.999866	0.999698	0.018322
3°10′	1°03′20″	0.999864	0.999695	0.018419
3°11′	1°03′40″	0.999863	0.999691	0.018516
3°12′	1°04′00″	0.999861	0.999688	0.018613
3°13′	1°04′20″	0.999860	0.999685	0.018710
3°14′	1°04′40″	0.999858	0.999682	0.018806
3°15′	1°05′00″	0.999857	0.999678	0.018903
3°16′	1°05′20″	0.999856	0.999675	0.019000
3°17′	1°05′40″	0.999854	0.999672	0.019097
3°18′	1°06′00″	0.999853	0.999668	0.019194
3°19′	1°06′20″	0.999851	0.999665	0.019291
3°20′	1°06′40″	0.999850	0.999662	0.019388
3°21′	1°07′00″	0.999848	0.999658	0.019485
3°22′	1°07′20″	0.999847	0.999655	0.019582
3°23′	1°07′40″	0.999845	0.999651	0.019679
3°24′	1°08′00″	0.999843	0.999648	0.019775
3°25′	1°08′20″	0.999842	0.999644	0.019872
3°26′	1°08′40″	0.999840	0.999641	0.019969
3°27′	1°09′00″	0.999839	0.999637	0.020066
3°28′	1°09′20″	0.999837	0.999634	0.020163
3°29′	1°09′40″	0.999836	0.999630	0.020260
3°30′	1°10′00″	0.999834	0.999627	0.020357
3°31′	1°10′20″	0.999833	0.999623	0.020454
3°32′	1°10′40″	0.999831	0.999620	0.020551
3°33′	1°11′00″	0.999829	0.999616	0.020647

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666743	0.333403	0.003902	0.499964	2°41′
0.666744	0.333404	0.003927	0.499963	2°42′
0.666745	0.333405	0.003951	0.499963	2°43′
0.666746	0.333406	0.003975	0.499962	2°44′
0.666747	0.333406	0.003999	0.499962	2°45′
0.666748	0.333407	0.004024	0.499961	2°46′
0.666749	0.333408	0.004048	0.499961	2°47′
0.666750	0.333409	0.004072	0.499960	2°48′
0.666751	0.333410	0.004096	0.499960	2°49′
0.666752	0.333411	0.004120	0.499959	2°50′
0.666753	0.333412	0.004145	0.499959	2°51′
0.666754	0.333413	0.004169	0.499958	2°52′
0.666755	0.333414	0.004193	0.499958	2°53′
0.666756	0.333415	0.004217	0.499957	2°54′
0.666757	0.333416	0.004242	0.499957	2°55′
0.666758	0.333417	0.004266	0.499956	2°56′
0.666759	0.333417	0.004290	0.499956	2°57′
0.666760	0.333418	0.004314	0.499955	2°58′
0.666761	0.333419	0.004339	0.499955	2°59′
0.666762	0.333420	0.004363	0.499954	3°00′
0.666764	0.333421	0.004387	0.499954	3°01′
0.666765	0.333422	0.004411	0.499953	3°02′
0.666766	0.333423	0.004436	0.499953	3°03′
0.666767	0.333424	0.004460	0.499952	3°04′
0.666768	0.333425	0.004484	0.499952	3°05′
0.666769	0.333426	0.004508	0.499951	3°06′
0.666770	0.333427	0.004532	0.499951	3°07′
0.666771	0.333428	0.004557	0.499950	3°08′
0.666772	0.333429	0.004581	0.499950	3°09′
0.666773	0.333430	0.004605	0.499949	3°10′
0.666775	0.333431	0.004629	0.499949	3°11′
0.666776	0.333432	0.004654	0.499948	3°12′
0.666777	0.333433	0.004678	0.499948	3°13′
0.666778	0.333434	0.004702	0.499947	3°14′
0.666779	0.333436	0.004726	0.499946	3°15′
0.666780	0.333437	0.004751	0.499946	3°16′
0.666781	0.333438	0.004775	0.499945	3°17′
0.666783	0.333439	0.004799	0.499945	3°18′
0.666784	0.333440	0.004823	0.499944	3°19′
0.666785	0.333441	0.004848	0.499944	3°20′
0.666786	0.333442	0.004872	0.499943	3°21′
0.666787	0.333443	0.004896	0.499943	3°22′
0.666788	0.333444	0.004920	0.499942	3°23′
0.666790	0.333445	0.004944	0.499941	3°24′
0.666791	0.333446	0.004969	0.499941	3°25′
0.666792	0.333447	0.004993	0.499940	3°26′
0.666793	0.333448	0.005017	0.499940	3°27′
0.666795	0.333450	0.005041	0.499939	3°28′
0.666796	0.333451	0.005066	0.499938	3°29′
0.666797	0.333452	0.005090	0.499938	3°30′
0.666798	0.333453	0.005114	0.499937	3°31′
0.666800	0.333454	0.005138	0.499937	3°32′
0.666801	0.333455	0.005163	0.499936	3°33′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
3°34′	1°11′20″	0.999828	0.999613	0.020744
3°35′	1°11′40″	0.999826	0.999609	0.020841
3°36′	1°12′00″	0.999825	0.999605	0.020938
3°37′	1°12′20″	0.999823	0.999602	0.021035
3°38′	1°12′40″	0.999821	0.999598	0.021132
3°39′	1°13′00″	0.999820	0.999594	0.021229
3°40′	1°13′20″	0.999818	0.999591	0.021326
3°41′	1°13′40″	0.999816	0.999587	0.021422
3°42′	1°14′00″	0.999815	0.999583	0.021519
3°43′	1°14′20″	0.999813	0.999579	0.021616
3°44′	1°14′40″	0.999811	0.999576	0.021713
3°45′	1°15′00″	0.999810	0.999572	0.021810
3°46′	1°15′20″	0.999808	0.999568	0.021907
3°47′	1°15′40″	0.999806	0.999564	0.022004
3°48′	1°16′00″	0.999805	0.999560	0.022101
3°49′	1°16′20″	0.999803	0.999556	0.022197
3°50′	1°16′40″	0.999801	0.999552	0.022294
3°51′	1°17′00″	0.999799	0.999549	0.022391
3°52′	1°17′20″	0.999798	0.999545	0.022488
3°53′	1°17′40″	0.999796	0.999541	0.022585
3°54′	1°18′00″	0.999794	0.999537	0.022682
3°55′	1°18′20″	0.999792	0.999533	0.022779
3°56′	1°18′40″	0.999791	0.999529	0.022875
3°57′	1°19′00″	0.999789	0.999525	0.022972
3°58′	1°19′20″	0.999787	0.999521	0.023069
3°59′	1°19′40″	0.999785	0.999517	0.023166
4°00′	1°20′00″	0.999783	0.999513	0.023263
4°01′	1°20′20″	0.999782	0.999509	0.023360
4°02′	1°20′40″	0.999780	0.999505	0.023457
4°03′	1°21′00″	0.999778	0.999500	0.023554
4°04′	1°21′20″	0.999776	0.999496	0.023650
4°05′	1°21′40″	0.999774	0.999492	0.023747
4°06′	1°22′00″	0.999772	0.999488	0.023844
4°07′	1°22′20″	0.999771	0.999484	0.023941
4°08′	1°22′40″	0.999769	0.999480	0.024038
4°09′	1°23′00″	0.999767	0.999475	0.024135
4°10′	1°23′20″	0.999765	0.999471	0.024232
4°11′	1°23′40″	0.999763	0.999467	0.024328
4°12′	1°24′00″	0.999761	0.999463	0.024425
4°13′	1°24′20″	0.999759	0.999459	0.024522
4°14′	1°24′40″	0.999757	0.999454	0.024619
4°15′	1°25′00″	0.999755	0.999450	0.024716
4°16′	1°25′20″	0.999754	0.999446	0.024813
4°17′	1°25′40″	0.999752	0.999441	0.024909
4°18′	1°26′00″	0.999750	0.999437	0.025006
4°19′	1°26′20″	0.999748	0.999433	0.025103
4°20′	1°26′40″	0.999746	0.999428	0.025200
4°21′	1°27′00″	0.999744	0.999424	0.025297
4°22′	1°27′20″	0.999742	0.999419	0.025394
4°23′	1°27′40″	0.999740	0.999415	0.025491
4°24′	1°28′00″	0.999738	0.999410	0.025587
4°25′	1°28′20″	0.999736	0.999406	0.025684
4°26′	1°28′40″	0.999734	0.999401	0.025781

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666802	0.333456	0.005187	0.499935	3°34′
0.666803	0.333458	0.005211	0.499935	3°35′
0.666805	0.333459	0.005235	0.499934	3°36′
0.666806	0.333460	0.005259	0.499934	3°37′
0.666807	0.333461	0.005284	0.499933	3°38′
0.666808	0.333462	0.005308	0.499932	3°39′
0.666810	0.333463	0.005332	0.499932	3°40′
0.666811	0.333465	0.005356	0.499931	3°41′
0.666812	0.333466	0.005381	0.499931	3°42′
0.666814	0.333467	0.005405	0.499930	3°43′
0.666815	0.333468	0.005429	0.499929	3°44′
0.666816	0.333469	0.005453	0.499929	3°45′
0.666818	0.333471	0.005477	0.499928	3°46′
0.666819	0.333472	0.005502	0.499927	3°47′
0.666820	0.333473	0.005526	0.499927	3°48′
0.666822	0.333474	0.005550	0.499926	3°49′
0.666823	0.333475	0.005574	0.499925	3°50′
0.666824	0.333477	0.005599	0.499925	3°51′
0.666826	0.333478	0.005623	0.499924	3°52′
0.666827	0.333479	0.005647	0.499923	3°53′
0.666829	0.333480	0.005671	0.499923	3°54′
0.666830	0.333482	0.005696	0.499922	3°55′
0.666831	0.333483	0.005720	0.499922	3°56′
0.666833	0.333484	0.005744	0.499921	3°57′
0.666834	0.333486	0.005768	0.499920	3°58′
0.666836	0.333487	0.005792	0.499920	3°59′
0.666837	0.333488	0.005817	0.499919	4°00′
0.666838	0.333489	0.005841	0.499918	4°01′
0.666840	0.333491	0.005865	0.499917	4°02′
0.666841	0.333492	0.005889	0.499917	4°03′
0.666843	0.333493	0.005914	0.499916	4°04′
0.666844	0.333495	0.005938	0.499915	4°05′
0.666846	0.333496	0.005962	0.499915	4°06′
0.666847	0.333497	0.005986	0.499914	4°07′
0.666849	0.333499	0.006011	0.499913	4°08′
0.666850	0.333500	0.006035	0.499913	4°09′
0.666851	0.333501	0.006059	0.499912	4°10′
0.666853	0.333503	0.006083	0.499911	4°11′
0.666854	0.333504	0.006107	0.499911	4°12′
0.666856	0.333505	0.006132	0.499910	4°13′
0.666857	0.333507	0.006156	0.499909	4°14′
0.666859	0.333508	0.006180	0.499908	4°15′
0.666860	0.333509	0.006204	0.499908	4°16′
0.666862	0.333511	0.006229	0.499907	4°17′
0.666863	0.333512	0.006253	0.499906	4°18′
0.666865	0.333514	0.006277	0.499905	4°19′
0.666867	0.333515	0.006301	0.499905	4°20′
0.666868	0.333516	0.006325	0.499904	4°21′
0.666870	0.333518	0.006350	0.499903	4°22′
0.666871	0.333519	0.006374	0.499903	4°23′
0.666873	0.333521	0.006398	0.499902	4°24′
0.666874	0.333522	0.006422	0.499901	4°25′
0.666876	0.333524	0.006447	0.499900	4°26′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
4°27′	1°29′00″	0.999732	0.999397	0.025878
4°28′	1°29′20″	0.999730	0.999392	0.025975
4°29′	1°29′40″	0.999728	0.999388	0.026072
4°30′	1°30′00″	0.999726	0.999383	0.026168
4°31′	1°30′20″	0.999724	0.999379	0.026265
4°32′	1°30′40″	0.999722	0.999374	0.026362
4°33′	1°31′00″	0.999720	0.999370	0.026459
4°34′	1°31′20″	0.999718	0.999365	0.026556
4°35′	1°31′40″	0.999716	0.999360	0.026653
4°36′	1°32′00″	0.999714	0.999356	0.026749
4°37′	1°32′20″	0.999711	0.999351	0.026846
4°38′	1°32′40″	0.999709	0.999346	0.026943
4°39′	1°33′00″	0.999707	0.999342	0.027040
4°40′	1°33′20″	0.999705	0.999337	0.027137
4°41′	1°33′40″	0.999703	0.999332	0.027234
4°42′	1°34′00″	0.999701	0.999327	0.027330
4°43′	1°34′20″	0.999699	0.999323	0.027427
4°44′	1°34′40″	0.999697	0.999318	0.027524
4°45′	1°35′00″	0.999695	0.999313	0.027621
4°46′	1°35′20″	0.999692	0.999308	0.027718
4°47′	1°35′40″	0.999690	0.999303	0.027814
4°48′	1°36′00″	0.999688	0.999298	0.027911
4°49′	1°36′20″	0.999686	0.999294	0.028008
4°50′	1°36′40″	0.999684	0.999289	0.028105
4°51′	1°37′00″	0.999682	0.999284	0.028202
4°52′	1°37′20″	0.999679	0.999279	0.028299
4°53′	1°37′40″	0.999677	0.999274	0.028395
4°54′	1°38′00″	0.999675	0.999269	0.028492
4°55′	1°38′20″	0.999673	0.999264	0.028589
4°56′	1°38′40″	0.999671	0.999259	0.028686
4°57′	1°39′00″	0.999668	0.999254	0.028783
4°58′	1°39′20″	0.999666	0.999249	0.028879
4°59′	1°39′40″	0.999664	0.999244	0.028976
5°00′	1°40′00″	0.999662	0.999239	0.029073
5°01′	1°40′20″	0.999659	0.999234	0.029170
5°02′	1°40′40″	0.999657	0.999229	0.029267
5°03′	1°41′00″	0.999655	0.999223	0.029363
5°04′	1°41′20″	0.999652	0.999218	0.029460
5°05′	1°41′40″	0.999650	0.999213	0.029557
5°06′	1°42′00″	0.999648	0.999208	0.029654
5°07′	1°42′20″	0.999646	0.999203	0.029751
5°08′	1°42′40″	0.999643	0.999198	0.029847
5°09′	1°43′00″	0.999641	0.999192	0.029944
5°10′	1°43′20″	0.999639	0.999187	0.030041
5°11′	1°43′40″	0.999636	0.999182	0.030138
5°12′	1°44′00″	0.999634	0.999177	0.030235
5°13′	1°44′20″	0.999632	0.999171	0.030331
5°14′	1°44′40″	0.999629	0.999166	0.030428
5°15′	1°45′00″	0.999627	0.999161	0.030525
5°16′	1°45′20″	0.999625	0.999155	0.030622
5°17′	1°45′40″	0.999622	0.999150	0.030719
5°18′	1°46′00″	0.999620	0.999145	0.030815
5°19′	1°46′20″	0.999617	0.999139	0.030912

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666877	0.333525	0.006471	0.499900	4°27′
0.666879	0.333526	0.006495	0.499899	4°28′
0.666881	0.333528	0.006519	0.499898	4°29′
0.666882	0.333529	0.006543	0.499897	4°30′
0.666884	0.333531	0.006568	0.499897	4°31′
0.666885	0.333532	0.006592	0.499896	4°32′
0.666887	0.333534	0.006616	0.499895	4°33′
0.666889	0.333535	0.006640	0.499894	4°34′
0.666890	0.333537	0.006665	0.499893	4°35′
0.666892	0.333538	0.006689	0.499893	4°36′
0.666894	0.333540	0.006713	0.499892	4°37′
0.666895	0.333541	0.006737	0.499891	4°38′
0.666897	0.333543	0.006762	0.499890	4°39′
0.666898	0.333544	0.006786	0.499890	4°40′
0.666900	0.333546	0.006810	0.499889	4°41′
0.666902	0.333547	0.006834	0.499888	4°42′
0.666904	0.333549	0.006858	0.499887	4°43′
0.666905	0.333550	0.006883	0.499886	4°44′
0.666907	0.333552	0.006907	0.499886	4°45′
0.666909	0.333553	0.006931	0.499885	4°46′
0.666910	0.333555	0.006955	0.499884	4°47′
0.666912	0.333556	0.006979	0.499883	4°48′
0.666914	0.333558	0.007004	0.499882	4°49′
0.666915	0.333559	0.007028	0.499881	4°50′
0.666917	0.333561	0.007052	0.499881	4°51′
0.666919	0.333563	0.007076	0.499880	4°52′
0.666921	0.333564	0.007101	0.499879	4°53′
0.666922	0.333566	0.007125	0.499878	4°54′
0.666924	0.333567	0.007149	0.499877	4°55′
0.666926	0.333569	0.007173	0.499877	4°56′
0.666928	0.333570	0.007198	0.499876	4°57′
0.666929	0.333572	0.007222	0.499875	4°58′
0.666931	0.333574	0.007246	0.499874	4°59′
0.666933	0.333575	0.007270	0.499873	5°00′
0.666935	0.333577	0.007294	0.499872	5°01′
0.666936	0.333578	0.007319	0.499871	5°02′
0.666938	0.333580	0.007343	0.499871	5°03′
0.666940	0.333582	0.007367	0.499870	5°04′
0.666942	0.333583	0.007391	0.499869	5°05′
0.666944	0.333585	0.007416	0.499868	5°06′
0.666945	0.333587	0.007440	0.499867	5°07′
0.666947	0.333588	0.007464	0.499866	5°08′
0.666949	0.333590	0.007488	0.499865	5°09′
0.666951	0.333592	0.007512	0.499865	5°10′
0.666953	0.333593	0.007537	0.499864	5°11′
0.666955	0.333595	0.007561	0.499863	5°12′
0.666956	0.333597	0.007585	0.499862	5°13′
0.666958	0.333598	0.007609	0.499861	5°14′
0.666960	0.333600	0.007633	0.499860	5°15′
0.666962	0.333602	0.007658	0.499859	5°16′
0.666964	0.333603	0.007682	0.499858	5°17′
0.666966	0.333605	0.007706	0.499857	5°18′
0.666968	0.333607	0.007730	0.499857	5°19′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
5°20′	1°46′40″	0.999615	0.999134	0.031009
5°21′	1°47′00″	0.999613	0.999128	0.031106
5°22′	1°47′20″	0.999610	0.999123	0.031202
5°23′	1°47′40″	0.999608	0.999118	0.031299
5°24′	1°48′00″	0.999605	0.999112	0.031396
5°25′	1°48′20″	0.999603	0.999107	0.031493
5°26′	1°48′39″	0.999600	0.999101	0.031590
5°27′	1°48′59″	0.999598	0.999096	0.031686
5°28′	1°49′19″	0.999595	0.999090	0.031783
5°29′	1°49′39″	0.999593	0.999084	0.031880
5°30′	1°49′59″	0.999591	0.999079	0.031977
5°31′	1°50′19″	0.999588	0.999073	0.032073
5°32′	1°50′39″	0.999586	0.999068	0.032170
5°33′	1°50′59″	0.999583	0.999062	0.032267
5°34′	1°51′19″	0.999581	0.999056	0.032364
5°35′	1°51′39″	0.999578	0.999051	0.032460
5°36′	1°51′59″	0.999575	0.999045	0.032557
5°37′	1°52′19″	0.999573	0.999039	0.032654
5°38′	1°52′39″	0.999570	0.999034	0.032751
5°39′	1°52′59″	0.999568	0.999028	0.032848
5°40′	1°53′19″	0.999565	0.999022	0.032944
5°41′	1°53′39″	0.999563	0.999017	0.033041
5°42′	1°53′59″	0.999560	0.999011	0.033138
5°43′	1°54′19″	0.999558	0.999005	0.033235
5°44′	1°54′39″	0.999555	0.998999	0.033331
5°45′	1°54′59″	0.999552	0.998993	0.033428
5°46′	1°55′19″	0.999550	0.998987	0.033525
5°47′	1°55′39″	0.999547	0.998982	0.033622
5°48′	1°55′59″	0.999545	0.998976	0.033718
5°49′	1°56′19″	0.999542	0.998970	0.033815
5°50′	1°56′39″	0.999539	0.998964	0.033912
5°51′	1°56′59″	0.999537	0.998958	0.034009
5°52′	1°57′19″	0.999534	0.998952	0.034105
5°53′	1°57′39″	0.999531	0.998946	0.034202
5°54′	1°57′59″	0.999529	0.998940	0.034299
5°55′	1°58′19″	0.999526	0.998934	0.034396
5°56′	1°58′39″	0.999523	0.998928	0.034492
5°57′	1°58′59″	0.999521	0.998922	0.034589
5°58′	1°59′19″	0.999518	0.998916	0.034686
5°59′	1°59′39″	0.999515	0.998910	0.034782
6°00′	1°59′59″	0.999513	0.998904	0.034879
6°01′	2°00′19″	0.999510	0.998898	0.034976
6°02′	2°00′39″	0.999507	0.998892	0.035073
6°03′	2°00′59″	0.999505	0.998886	0.035169
6°04′	2°01′19″	0.999502	0.998879	0.035266
6°05′	2°01′39″	0.999499	0.998873	0.035363
6°06′	2°01′59″	0.999496	0.998867	0.035460
6°07′	2°02′19″	0.999494	0.998861	0.035556
6°08′	2°02′39″	0.999491	0.998855	0.035653
6°09′	2°02′59″	0.999488	0.998848	0.035750
6°10′	2°03′19″	0.999485	0.998842	0.035847
6°11′	2°03′39″	0.999482	0.998836	0.035943
6°12′	2°03′59″	0.999480	0.998830	0.036040

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.666970	0.333609	0.007755	0.499856	5°20′
0.666971	0.333610	0.007779	0.499855	5°21′
0.666973	0.333612	0.007803	0.499854	5°22′
0.666975	0.333614	0.007827	0.499853	5°23′
0.666977	0.333616	0.007851	0.499852	5°24′
0.666979	0.333617	0.007876	0.499851	5°25′
0.666981	0.333619	0.007900	0.499850	5°26′
0.666983	0.333621	0.007924	0.499849	5°27′
0.666985	0.333623	0.007948	0.499848	5°28′
0.666987	0.333624	0.007973	0.499847	5°29′
0.666989	0.333626	0.007997	0.499847	5°30′
0.666991	0.333628	0.008021	0.499846	5°31′
0.666993	0.333630	0.008045	0.499845	5°32′
0.666995	0.333631	0.008069	0.499844	5°33′
0.666997	0.333633	0.008094	0.499843	5°34′
0.666999	0.333635	0.008118	0.499842	5°35′
0.667001	0.333637	0.008142	0.499841	5°36′
0.667003	0.333639	0.008166	0.499840	5°37′
0.667005	0.333641	0.008190	0.499839	5°38′
0.667007	0.333642	0.008215	0.499838	5°39′
0.667009	0.333644	0.008239	0.499837	5°40′
0.667011	0.333646	0.008263	0.499836	5°41′
0.667013	0.333648	0.008287	0.499835	5°42′
0.667015	0.333650	0.008312	0.499834	5°43′
0.667017	0.333651	0.008336	0.499833	5°44′
0.667019	0.333653	0.008360	0.499832	5°45′
0.667021	0.333655	0.008384	0.499831	5°46′
0.667023	0.333657	0.008408	0.499830	5°47′
0.667025	0.333659	0.008433	0.499829	5°48′
0.667027	0.333661	0.008457	0.499828	5°49′
0.667029	0.333663	0.008481	0.499827	5°50′
0.667031	0.333665	0.008505	0.499826	5°51′
0.667033	0.333667	0.008529	0.499825	5°52′
0.667035	0.333668	0.008554	0.499824	5°53′
0.667037	0.333670	0.008578	0.499823	5°54′
0.667039	0.333672	0.008602	0.499822	5°55′
0.667042	0.333674	0.008626	0.499821	5°56′
0.667044	0.333676	0.008651	0.499820	5°57′
0.667046	0.333678	0.008675	0.499819	5°58′
0.667048	0.333680	0.008699	0.499818	5°59′
0.667050	0.333682	0.008723	0.499817	6°00′
0.667052	0.333684	0.008747	0.499816	6°01′
0.667054	0.333686	0.008772	0.499815	6°02′
0.667056	0.333688	0.008796	0.499814	6°03′
0.667059	0.333690	0.008820	0.499813	6°04′
0.667061	0.333692	0.008844	0.499812	6°05′
0.667063	0.333694	0.008868	0.499811	6°06′
0.667065	0.333696	0.008893	0.499810	6°07′
0.667067	0.333698	0.008917	0.499809	6°08′
0.667069	0.333699	0.008941	0.499808	6°09′
0.667072	0.333701	0.008965	0.499807	6°10′
0.667074	0.333703	0.008990	0.499806	6°11′
0.667076	0.333706	0.009014	0.499805	6°12′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
6°13′	2°04′19″	0.999477	0.998823	0.036137
6°14′	2°04′39″	0.999474	0.998817	0.036233
6°15′	2°04′59″	0.999471	0.998811	0.036330
6°16′	2°05′19″	0.999468	0.998804	0.036427
6°17′	2°05′39″	0.999466	0.998798	0.036524
6°18′	2°05′59″	0.999463	0.998792	0.036620
6°19′	2°06′19″	0.999460	0.998785	0.036717
6°20′	2°06′39″	0.999457	0.998779	0.036814
6°21′	2°06′59″	0.999454	0.998772	0.036910
6°22′	2°07′19″	0.999451	0.998766	0.037007
6°23′	2°07′39″	0.999448	0.998759	0.037104
6°24′	2°07′59″	0.999446	0.998753	0.037200
6°25′	2°08′19″	0.999443	0.998746	0.037297
6°26′	2°08′39″	0.999440	0.998740	0.037394
6°27′	2°08′59″	0.999437	0.998733	0.037491
6°28′	2°09′19″	0.999434	0.998727	0.037587
6°29′	2°09′39″	0.999431	0.998720	0.037684
6°30′	2°09′59″	0.999428	0.998714	0.037781
6°31′	2°10′19″	0.999425	0.998707	0.037877
6°32′	2°10′39″	0.999422	0.998701	0.037974
6°33′	2°10′59″	0.999419	0.998694	0.038071
6°34′	2°11′19″	0.999416	0.998687	0.038167
6°35′	2°11′39″	0.999413	0.998681	0.038264
6°36′	2°11′59″	0.999410	0.998674	0.038361
6°37′	2°12′19″	0.999407	0.998667	0.038457
6°38′	2°12′39″	0.999404	0.998660	0.038554
6°39′	2°12′59″	0.999401	0.998654	0.038651
6°40′	2°13′19″	0.999398	0.998647	0.038747
6°41′	2°13′39″	0.999395	0.998640	0.038844
6°42′	2°13′59″	0.999392	0.998633	0.038941
6°43′	2°14′19″	0.999389	0.998627	0.039038
6°44′	2°14′39″	0.999386	0.998620	0.039134
6°45′	2°14′59″	0.999383	0.998613	0.039231
6°46′	2°15′19″	0.999380	0.998606	0.039328
6°47′	2°15′39″	0.999377	0.998599	0.039424
6°48′	2°15′59″	0.999374	0.998592	0.039521
6°49′	2°16′19″	0.999371	0.998585	0.039618
6°50′	2°16′39″	0.999368	0.998579	0.039714
6°51′	2°16′59″	0.999365	0.998572	0.039811
6°52′	2°17′19″	0.999362	0.998565	0.039908
6°53′	2°17′39″	0.999359	0.998558	0.040004
6°54′	2°17′59″	0.999356	0.998551	0.040101
6°55′	2°18′19″	0.999352	0.998544	0.040198
6°56′	2°18′39″	0.999349	0.998537	0.040294
6°57′	2°18′59″	0.999346	0.998530	0.040391
6°58′	2°19′19″	0.999343	0.998523	0.040487
6°59′	2°19′39″	0.999340	0.998515	0.040584
7°00′	2°19′59″	0.999337	0.998508	0.040681
7°01′	2°20′19″	0.999334	0.998501	0.040778
7°02′	2°20′39″	0.999330	0.998494	0.040874
7°03′	2°20′59″	0.999327	0.998487	0.040971
7°04′	2°21′19″	0.999324	0.998480	0.041068
7°05′	2°21′39″	0.999321	0.998473	0.041164

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667078	0.333707	0.009038	0.499804	6°13′
0.667080	0.333709	0.009062	0.499803	6°14′
0.667083	0.333712	0.009086	0.499802	6°15′
0.667085	0.333714	0.009111	0.499801	6°16′
0.667087	0.333716	0.009135	0.499800	6°17′
0.667089	0.333718	0.009159	0.499799	6°18′
0.667092	0.333720	0.009183	0.499798	6°19′
0.667094	0.333722	0.009207	0.499796	6°20′
0.667096	0.333724	0.009232	0.499795	6°21′
0.667098	0.333726	0.009256	0.499794	6°22′
0.667101	0.333728	0.009280	0.499793	6°23′
0.667103	0.333730	0.009304	0.499792	6°24′
0.667105	0.333732	0.009328	0.499791	6°25′
0.667107	0.333734	0.009353	0.499790	6°26′
0.667110	0.333736	0.009377	0.499789	6°27′
0.667112	0.333738	0.009401	0.499788	6°28′
0.667114	0.333740	0.009425	0.499787	6°29′
0.667117	0.333742	0.009449	0.499786	6°30′
0.667119	0.333745	0.009474	0.499785	6°31′
0.667121	0.333747	0.009498	0.499783	6°32′
0.667124	0.333749	0.009522	0.499782	6°33′
0.667126	0.333751	0.009546	0.499781	6°34′
0.667128	0.333753	0.009570	0.499780	6°35′
0.667131	0.333755	0.009595	0.499779	6°36′
0.667133	0.333757	0.009619	0.499778	6°37′
0.667135	0.333759	0.009643	0.499777	6°38′
0.667138	0.333762	0.009667	0.499776	6°39′
0.667140	0.333764	0.009692	0.499775	6°40′
0.667142	0.333766	0.009716	0.499773	6°41′
0.667145	0.333768	0.009740	0.499772	6°42′
0.667147	0.333770	0.009764	0.499771	6°43′
0.667150	0.333772	0.009788	0.499770	6°44′
0.667152	0.333775	0.009813	0.499769	6°45′
0.667154	0.333777	0.009837	0.499768	6°46′
0.667157	0.333779	0.009861	0.499767	6°47′
0.667159	0.333781	0.009885	0.499765	6°48′
0.667162	0.333783	0.009909	0.499764	6°49′
0.667164	0.333786	0.009934	0.499763	6°50′
0.667166	0.333788	0.009958	0.499762	6°51′
0.667169	0.333790	0.009982	0.499761	6°52′
0.667171	0.333792	0.010006	0.499760	6°53′
0.667174	0.333794	0.010030	0.499758	6°54′
0.667176	0.333797	0.010055	0.499757	6°55′
0.667179	0.333799	0.010079	0.499756	6°56′
0.667181	0.333801	0.010103	0.499755	6°57′
0.667184	0.333803	0.010127	0.499754	6°58′
0.667186	0.333806	0.010151	0.499753	6°59′
0.667189	0.333808	0.010176	0.499751	7°00′
0.667191	0.333810	0.010200	0.499750	7°01′
0.667194	0.333812	0.010224	0.499749	7°02′
0.667196	0.333815	0.010248	0.499748	7°03′
0.667199	0.333817	0.010272	0.499747	7°04′
0.667201	0.333819	0.010297	0.499745	7°05′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
7°06′	2°21′59″	0.999318	0.998466	0.041261
7°07′	2°22′19″	0.999314	0.998458	0.041357
7°08′	2°22′39″	0.999311	0.998451	0.041454
7°09′	2°22′59″	0.999308	0.998444	0.041551
7°10′	2°23′19″	0.999305	0.998437	0.041647
7°11′	2°23′39″	0.999302	0.998429	0.041744
7°12′	2°23′59″	0.999298	0.998422	0.041841
7°13′	2°24′19″	0.999295	0.998415	0.041937
7°14′	2°24′39″	0.999292	0.998407	0.042034
7°15′	2°24′59″	0.999289	0.998400	0.042131
7°16′	2°25′19″	0.999285	0.998393	0.042227
7°17′	2°25′39″	0.999282	0.998385	0.042324
7°18′	2°25′59″	0.999279	0.998378	0.042420
7°19′	2°26′19″	0.999275	0.998370	0.042517
7°20′	2°26′39″	0.999272	0.998363	0.042614
7°21′	2°26′59″	0.999269	0.998356	0.042710
7°22′	2°27′19″	0.999265	0.998348	0.042807
7°23′	2°27′39″	0.999262	0.998341	0.042904
7°24′	2°27′59″	0.999259	0.998333	0.043000
7°25′	2°28′19″	0.999255	0.998326	0.043097
7°26′	2°28′39″	0.999252	0.998318	0.043193
7°27′	2°28′59″	0.999249	0.998311	0.043290
7°28′	2°29′19″	0.999245	0.998303	0.043387
7°29′	2°29′39″	0.999242	0.998295	0.043483
7°30′	2°29′59″	0.999239	0.998288	0.043580
7°31′	2°30′19″	0.999235	0.998280	0.043676
7°32′	2°30′39″	0.999232	0.998273	0.043773
7°33′	2°30′59″	0.999228	0.998265	0.043870
7°34′	2°31′19″	0.999225	0.998257	0.043966
7°35′	2°31′39″	0.999222	0.998250	0.044063
7°36′	2°31′59″	0.999218	0.998242	0.044159
7°37′	2°32′19″	0.999215	0.998234	0.044256
7°38′	2°32′39″	0.999211	0.998227	0.044353
7°39′	2°32′59″	0.999208	0.998219	0.044449
7°40′	2°33′19″	0.999204	0.998211	0.044546
7°41′	2°33′39″	0.999201	0.998203	0.044642
7°42′	2°33′59″	0.999198	0.998195	0.044739
7°43′	2°34′19″	0.999194	0.998188	0.044835
7°44′	2°34′39″	0.999191	0.998180	0.044932
7°45′	2°34′59″	0.999187	0.998172	0.045029
7°46′	2°35′19″	0.999184	0.998164	0.045125
7°47′	2°35′39″	0.999180	0.998156	0.045222
7°48′	2°35′58″	0.999177	0.998148	0.045318
7°49′	2°36′18″	0.999173	0.998140	0.045415
7°50′	2°36′38″	0.999169	0.998132	0.045512
7°51′	2°36′58″	0.999166	0.998125	0.045608
7°52′	2°37′18″	0.999162	0.998117	0.045705
7°53′	2°37′38″	0.999159	0.998109	0.045801
7°54′	2°37′58″	0.999155	0.998101	0.045898
7°55′	2°38′18″	0.999152	0.998093	0.045994
7°56′	2°38′38″	0.999148	0.998085	0.046091
7°57′	2°38′58″	0.999145	0.998076	0.046187
7°58′	2°39′18″	0.999141	0.998068	0.046284

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667204	0.333822	0.010321	0.499744	7°06′
0.667206	0.333824	0.010345	0.499743	7°07′
0.667209	0.333826	0.010369	0.499742	7°08′
0.667211	0.333828	0.010393	0.499741	7°09′
0.667214	0.333831	0.010418	0.499739	7°10′
0.667216	0.333833	0.010442	0.499738	7°11′
0.667219	0.333835	0.010466	0.499737	7°12′
0.667222	0.333838	0.010490	0.499736	7°13′
0.667224	0.333840	0.010514	0.499735	7°14′
0.667227	0.333842	0.010539	0.499733	7°15′
0.667229	0.333845	0.010563	0.499732	7°16′
0.667232	0.333847	0.010587	0.499731	7°17′
0.667234	0.333850	0.010611	0.499730	7°18′
0.667237	0.333852	0.010635	0.499728	7°19′
0.667240	0.333854	0.010660	0.499727	7°20′
0.667242	0.333857	0.010684	0.499726	7°21′
0.667245	0.333859	0.010708	0.499725	7°22′
0.667247	0.333861	0.010732	0.499723	7°23′
0.667250	0.333864	0.010756	0.499722	7°24′
0.667253	0.333866	0.010781	0.499721	7°25′
0.667255	0.333869	0.010805	0.499720	7°26′
0.667258	0.333871	0.010829	0.499718	7°27′
0.667261	0.333873	0.010853	0.499717	7°28′
0.667263	0.333876	0.010877	0.499716	7°29′
0.667266	0.333878	0.010902	0.499715	7°30′
0.667269	0.333881	0.010926	0.499713	7°31′
0.667271	0.333883	0.010950	0.499712	7°32′
0.667274	0.333886	0.010974	0.499711	7°33′
0.667277	0.333888	0.010998	0.499710	7°34′
0.667279	0.333890	0.011023	0.499708	7°35′
0.667282	0.333893	0.011047	0.499707	7°36′
0.667285	0.333895	0.011071	0.499706	7°37′
0.667288	0.333898	0.011095	0.499704	7°38′
0.667290	0.333900	0.011119	0.499703	7°39′
0.667293	0.333903	0.011144	0.499702	7°40′
0.667296	0.333905	0.011168	0.499701	7°41′
0.667298	0.333908	0.011192	0.499699	7°42′
0.667301	0.333910	0.011216	0.499698	7°43′
0.667304	0.333913	0.011240	0.499697	7°44′
0.667307	0.333915	0.011264	0.499695	7°45′
0.667309	0.333918	0.011289	0.499694	7°46′
0.667312	0.333920	0.011313	0.499693	7°47′
0.667315	0.333923	0.011337	0.499691	7°48′
0.667318	0.333925	0.011361	0.499690	7°49′
0.667321	0.333928	0.011385	0.499689	7°50′
0.667323	0.333930	0.011410	0.499687	7°51′
0.667326	0.333933	0.011434	0.499686	7°52′
0.667329	0.333935	0.011458	0.499685	7°53′
0.667332	0.333938	0.011482	0.499683	7°54′
0.667335	0.333941	0.011506	0.499682	7°55′
0.667337	0.333943	0.011531	0.499681	7°56′
0.667340	0.333946	0.011555	0.499679	7°57′
0.667343	0.333948	0.011579	0.499678	7°58′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
7°59′	2°39′38″	0.999137	0.998060	0.046381
8°00′	2°39′58″	0.999134	0.998052	0.046477
8°01′	2°40′18″	0.999130	0.998044	0.046574
8°02′	2°40′38″	0.999127	0.998036	0.046670
8°03′	2°40′58″	0.999123	0.998028	0.046767
8°04′	2°41′18″	0.999119	0.998020	0.046864
8°05′	2°41′38″	0.999116	0.998011	0.046960
8°06′	2°41′58″	0.999112	0.998003	0.047057
8°07′	2°42′18″	0.999108	0.997995	0.047153
8°08′	2°42′38″	0.999105	0.997987	0.047250
8°09′	2°42′58″	0.999101	0.997979	0.047346
8°10′	2°43′18″	0.999097	0.997970	0.047443
8°11′	2°43′38″	0.999094	0.997962	0.047539
8°12′	2°43′58″	0.999090	0.997954	0.047636
8°13′	2°44′18″	0.999086	0.997945	0.047732
8°14′	2°44′38″	0.999083	0.997937	0.047829
8°15′	2°44′58″	0.999079	0.997929	0.047925
8°16′	2°45′18″	0.999075	0.997920	0.048022
8°17′	2°45′38″	0.999071	0.997912	0.048119
8°18′	2°45′58″	0.999068	0.997904	0.048215
8°19′	2°46′18″	0.999064	0.997895	0.048312
8°20′	2°46′38″	0.999060	0.997887	0.048408
8°21′	2°46′58″	0.999056	0.997878	0.048505
8°22′	2°47′18″	0.999053	0.997870	0.048601
8°23′	2°47′38″	0.999049	0.997861	0.048698
8°24′	2°47′58″	0.999045	0.997853	0.048794
8°25′	2°48′18″	0.999041	0.997844	0.048891
8°26′	2°48′38″	0.999037	0.997836	0.048987
8°27′	2°48′58″	0.999034	0.997827	0.049084
8°28′	2°49′18″	0.999030	0.997819	0.049180
8°29′	2°49′38″	0.999026	0.997810	0.049277
8°30′	2°49′58″	0.999022	0.997801	0.049373
8°31′	2°50′18″	0.999018	0.997793	0.049470
8°32′	2°50′38″	0.999014	0.997784	0.049566
8°33′	2°50′58″	0.999011	0.997775	0.049663
8°34′	2°51′18″	0.999007	0.997767	0.049759
8°35′	2°51′38″	0.999003	0.997758	0.049856
8°36′	2°51′58″	0.998999	0.997749	0.049952
8°37′	2°52′18″	0.998995	0.997741	0.050049
8°38′	2°52′38″	0.998991	0.997732	0.050145
8°39′	2°52′58″	0.998987	0.997723	0.050242
8°40′	2°53′18″	0.998983	0.997714	0.050338
8°41′	2°53′38″	0.998980	0.997706	0.050435
8°42′	2°53′58″	0.998976	0.997697	0.050531
8°43′	2°54′18″	0.998972	0.997688	0.050628
8°44′	2°54′38″	0.998968	0.997679	0.050724
8°45′	2°54′58″	0.998964	0.997670	0.050821
8°46′	2°55′18″	0.998960	0.997661	0.050917
8°47′	2°55′38″	0.998956	0.997653	0.051014
8°48′	2°55′58″	0.998952	0.997644	0.051110
8°49′	2°56′18″	0.998948	0.997635	0.051206
8°50′	2°56′38″	0.998944	0.997626	0.051303
8°51′	2°56′58″	0.998940	0.997617	0.051399

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667346	0.333951	0.011603	0.499677	7°59′
0.667349	0.333953	0.011627	0.499675	8°00′
0.667352	0.333956	0.011652	0.499674	8°01′
0.667354	0.333959	0.011676	0.499673	8°02′
0.667357	0.333961	0.011700	0.499671	8°03′
0.667360	0.333964	0.011724	0.499670	8°04′
0.667363	0.333966	0.011748	0.499669	8°05′
0.667366	0.333969	0.011773	0.499667	8°06′
0.667369	0.333972	0.011797	0.499666	8°07′
0.667372	0.333974	0.011821	0.499664	8°08′
0.667375	0.333977	0.011845	0.499663	8°09′
0.667378	0.333980	0.011869	0.499662	8°10′
0.667380	0.333982	0.011893	0.499660	8°11′
0.667383	0.333985	0.011918	0.499659	8°12′
0.667386	0.333988	0.011942	0.499658	8°13′
0.667389	0.333990	0.011966	0.499656	8°14′
0.667392	0.333993	0.011990	0.499655	8°15′
0.667395	0.333996	0.012014	0.499653	8°16′
0.667398	0.333998	0.012039	0.499652	8°17′
0.667401	0.334001	0.012063	0.499650	8°18′
0.667404	0.334004	0.012087	0.499649	8°19′
0.667407	0.334006	0.012111	0.499648	8°20′
0.667410	0.334009	0.012135	0.499646	8°21′
0.667413	0.334012	0.012160	0.499645	8°22′
0.667416	0.334014	0.012184	0.499643	8°23′
0.667419	0.334017	0.012208	0.499642	8°24′
0.667422	0.334020	0.012232	0.499641	8°25′
0.667425	0.334023	0.012256	0.499639	8°26′
0.667428	0.334025	0.012280	0.499638	8°27′
0.667431	0.334028	0.012305	0.499636	8°28′
0.667434	0.334031	0.012329	0.499635	8°29′
0.667437	0.334034	0.012353	0.499633	8°30′
0.667440	0.334036	0.012377	0.499632	8°31′
0.667443	0.334039	0.012401	0.499631	8°32′
0.667446	0.334042	0.012426	0.499629	8°33′
0.667449	0.334045	0.012450	0.499628	8°34′
0.667452	0.334047	0.012474	0.499626	8°35′
0.667455	0.334050	0.012498	0.499625	8°36′
0.667458	0.334053	0.012522	0.499623	8°37′
0.667461	0.334056	0.012546	0.499622	8°38′
0.667464	0.334059	0.012571	0.499620	8°39′
0.667467	0.334061	0.012595	0.499619	8°40′
0.667471	0.334064	0.012619	0.499617	8°41′
0.667474	0.334067	0.012643	0.499616	8°42′
0.667477	0.334070	0.012667	0.499615	8°43′
0.667480	0.334073	0.012692	0.499613	8°44′
0.667483	0.334075	0.012716	0.499612	8°45′
0.667486	0.334078	0.012740	0.499610	8°46′
0.667489	0.334081	0.012764	0.499609	8°47′
0.667492	0.334084	0.012788	0.499607	8°48′
0.667495	0.334087	0.012812	0.499606	8°49′
0.667499	0.334090	0.012837	0.499604	8°50′
0.667502	0.334093	0.012861	0.499603	8°51′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
8°52′	2°57′18″	0.998936	0.997608	0.051496
8°53′	2°57′38″	0.998932	0.997599	0.051592
8°54′	2°57′58″	0.998928	0.997590	0.051689
8°55′	2°58′18″	0.998924	0.997581	0.051785
8°56′	2°58′38″	0.998920	0.997572	0.051882
8°57′	2°58′58″	0.998916	0.997563	0.051978
8°58′	2°59′18″	0.998912	0.997554	0.052075
8°59′	2°59′38″	0.998908	0.997545	0.052171
9°00′	2°59′58″	0.998904	0.997535	0.052268
9°01′	3°00′18″	0.998900	0.997526	0.052364
9°02′	3°00′38″	0.998896	0.997517	0.052461
9°03′	3°00′58″	0.998892	0.997508	0.052557
9°04′	3°01′18″	0.998888	0.997499	0.052653
9°05′	3°01′38″	0.998883	0.997490	0.052750
9°06′	3°01′58″	0.998879	0.997480	0.052846
9°07′	3°02′18″	0.998875	0.997471	0.052943
9°08′	3°02′38″	0.998871	0.997462	0.053039
9°09′	3°02′58″	0.998867	0.997453	0.053136
9°10′	3°03′18″	0.998863	0.997443	0.053232
9°11′	3°03′38″	0.998859	0.997434	0.053328
9°12′	3°03′58″	0.998855	0.997425	0.053425
9°13′	3°04′18″	0.998850	0.997415	0.053521
9°14′	3°04′38″	0.998846	0.997406	0.053618
9°15′	3°04′58″	0.998842	0.997397	0.053714
9°16′	3°05′18″	0.998838	0.997387	0.053811
9°17′	3°05′38″	0.998834	0.997378	0.053907
9°18′	3°05′57″	0.998830	0.997369	0.054003
9°19′	3°06′17″	0.998825	0.997359	0.054100
9°20′	3°06′37″	0.998821	0.997350	0.054196
9°21′	3°06′57″	0.998817	0.997340	0.054293
9°22′	3°07′17″	0.998813	0.997331	0.054389
9°23′	3°07′37″	0.998808	0.997321	0.054485
9°24′	3°07′57″	0.998804	0.997312	0.054582
9°25′	3°08′17″	0.998800	0.997302	0.054678
9°26′	3°08′37″	0.998796	0.997293	0.054775
9°27′	3°08′57″	0.998791	0.997283	0.054871
9°28′	3°09′17″	0.998787	0.997274	0.054967
9°29′	3°09′37″	0.998783	0.997264	0.055064
9°30′	3°09′57″	0.998779	0.997254	0.055160
9°31′	3°10′17″	0.998774	0.997245	0.055257
9°32′	3°10′37″	0.998770	0.997235	0.055353
9°33′	3°10′57″	0.998766	0.997225	0.055449
9°34′	3°11′17″	0.998761	0.997216	0.055546
9°35′	3°11′37″	0.998757	0.997206	0.055642
9°36′	3°11′57″	0.998753	0.997196	0.055739
9°37′	3°12′17″	0.998749	0.997187	0.055835
9°38′	3°12′37″	0.998744	0.997177	0.055931
9°39′	3°12′57″	0.998740	0.997167	0.056028
9°40′	3°13′17″	0.998735	0.997157	0.056124
9°41′	3°13′37″	0.998731	0.997147	0.056220
9°42′	3°13′57″	0.998727	0.997138	0.056317
9°43′	3°14′17″	0.998722	0.997128	0.056413
9°44′	3°14′37″	0.998718	0.997118	0.056509

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667505	0.334095	0.012885	0.499601	8°52′
0.667508	0.334098	0.012909	0.499600	8°53′
0.667511	0.334101	0.012933	0.499598	8°54′
0.667514	0.334104	0.012957	0.499597	8°55′
0.667518	0.334107	0.012982	0.499595	8°56′
0.667521	0.334110	0.013006	0.499594	8°57′
0.667524	0.334113	0.013030	0.499592	8°58′
0.667527	0.334116	0.013054	0.499591	8°59′
0.667530	0.334119	0.013078	0.499589	9°00′
0.667534	0.334122	0.013103	0.499588	9°01′
0.667537	0.334124	0.013127	0.499586	9°02′
0.667540	0.334127	0.013151	0.499585	9°03′
0.667543	0.334130	0.013175	0.499583	9°04′
0.667546	0.334133	0.013199	0.499581	9°05′
0.667550	0.334136	0.013223	0.499580	9°06′
0.667553	0.334139	0.013248	0.499578	9°07′
0.667556	0.334142	0.013272	0.499577	9°08′
0.667559	0.334145	0.013296	0.499575	9°09′
0.667563	0.334148	0.013320	0.499574	9°10′
0.667566	0.334151	0.013344	0.499572	9°11′
0.667569	0.334154	0.013368	0.499571	9°12′
0.667573	0.334157	0.013393	0.499569	9°13′
0.667576	0.334160	0.013417	0.499568	9°14′
0.667579	0.334163	0.013441	0.499566	9°15′
0.667582	0.334166	0.013465	0.499564	9°16′
0.667586	0.334169	0.013489	0.499563	9°17′
0.667589	0.334172	0.013514	0.499561	9°18′
0.667592	0.334175	0.013538	0.499560	9°19′
0.667596	0.334178	0.013562	0.499558	9°20′
0.667599	0.334181	0.013586	0.499557	9°21′
0.667602	0.334184	0.013610	0.499555	9°22′
0.667606	0.334187	0.013634	0.499553	9°23′
0.667609	0.334190	0.013659	0.499552	9°24′
0.667612	0.334193	0.013683	0.499550	9°25′
0.667616	0.334196	0.013707	0.499549	9°26′
0.667619	0.334199	0.013731	0.499547	9°27′
0.667622	0.334202	0.013755	0.499545	9°28′
0.667626	0.334205	0.013779	0.499544	9°29′
0.667629	0.334209	0.013804	0.499542	9°30′
0.667633	0.334212	0.013828	0.499541	9°31′
0.667636	0.334215	0.013852	0.499539	9°32′
0.667639	0.334218	0.013876	0.499537	9°33′
0.667643	0.334221	0.013900	0.499536	9°34′
0.667646	0.334224	0.013924	0.499534	9°35′
0.667650	0.334227	0.013949	0.499533	9°36′
0.667653	0.334230	0.013973	0.499531	9°37′
0.667657	0.334233	0.013997	0.499529	9°38′
0.667660	0.334236	0.014021	0.499528	9°39′
0.667663	0.334240	0.014045	0.499526	9°40′
0.667667	0.334243	0.014069	0.499524	9°41′
0.667670	0.334246	0.014094	0.499523	9°42′
0.667674	0.334249	0.014118	0.499521	9°43′
0.667677	0.334252	0.014142	0.499519	9°44′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
9°45′	3°14′57″	0.998714	0.997108	0.056606
9°46′	3°15′17″	0.998709	0.997098	0.056702
9°47′	3°15′37″	0.998705	0.997088	0.056799
9°48′	3°15′57″	0.998700	0.997078	0.056895
9°49′	3°16′17″	0.998696	0.997068	0.056991
9°50′	3°16′37″	0.998691	0.997059	0.057088
9°51′	3°16′57″	0.998687	0.997049	0.057184
9°52′	3°17′17″	0.998683	0.997039	0.057280
9°53′	3°17′37″	0.998678	0.997029	0.057377
9°54′	3°17′57″	0.998674	0.997019	0.057473
9°55′	3°18′17″	0.998669	0.997009	0.057569
9°56′	3°18′37″	0.998665	0.996998	0.057666
9°57′	3°18′57″	0.998660	0.996988	0.057762
9°58′	3°19′17″	0.998656	0.996978	0.057858
9°59′	3°19′37″	0.998651	0.996968	0.057955
10°00′	3°19′57″	0.998647	0.996958	0.058051
10°01′	3°20′17″	0.998642	0.996948	0.058148
10°02′	3°20′37″	0.998638	0.996938	0.058244
10°03′	3°20′57″	0.998633	0.996928	0.058340
10°04′	3°21′17″	0.998629	0.996917	0.058436
10°05′	3°21′37″	0.998624	0.996907	0.058533
10°06′	3°21′57″	0.998620	0.996897	0.058629
10°07′	3°22′17″	0.998615	0.996887	0.058725
10°08′	3°22′37″	0.998610	0.996877	0.058822
10°09′	3°22′57″	0.998606	0.996866	0.058918
10°10′	3°23′17″	0.998601	0.996856	0.059014
10°11′	3°23′37″	0.998597	0.996846	0.059111
10°12′	3°23′57″	0.998592	0.996835	0.059207
10°13′	3°24′17″	0.998588	0.996825	0.059303
10°14′	3°24′37″	0.998583	0.996815	0.059400
10°15′	3°24′57″	0.998578	0.996804	0.059496
10°16′	3°25′17″	0.998574	0.996794	0.059592
10°17′	3°25′37″	0.998569	0.996784	0.059688
10°18′	3°25′57″	0.998564	0.996773	0.059785
10°19′	3°26′17″	0.998560	0.996763	0.059881
10°20′	3°26′37″	0.998555	0.996752	0.059977
10°21′	3°26′57″	0.998550	0.996742	0.060074
10°22′	3°27′17″	0.998546	0.996731	0.060170
10°23′	3°27′37″	0.998541	0.996721	0.060266
10°24′	3°27′56″	0.998536	0.996710	0.060362
10°25′	3°28′16″	0.998532	0.996700	0.060459
10°26′	3°28′36″	0.998527	0.996689	0.060555
10°27′	3°28′56″	0.998522	0.996679	0.060651
10°28′	3°29′16″	0.998518	0.996668	0.060748
10°29′	3°29′36″	0.998513	0.996657	0.060844
10°30′	3°29′56″	0.998508	0.996647	0.060940
10°31′	3°30′16″	0.998503	0.996636	0.061036
10°32′	3°30′36″	0.998499	0.996626	0.061133
10°33′	3°30′56″	0.998494	0.996615	0.061229
10°34′	3°31′16″	0.998489	0.996604	0.061325
10°35′	3°31′36″	0.998484	0.996593	0.061421
10°36′	3°31′56″	0.998480	0.996583	0.061518
10°37′	3°32′16″	0.998475	0.996572	0.061614

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667681	0.334255	0.014166	0.499518	9°45′
0.667684	0.334259	0.014190	0.499516	9°46′
0.667688	0.334262	0.014214	0.499515	9°47′
0.667691	0.334265	0.014239	0.499513	9°48′
0.667695	0.334268	0.014263	0.499511	9°49′
0.667698	0.334271	0.014287	0.499510	9°50′
0.667702	0.334274	0.014311	0.499508	9°51′
0.667705	0.334278	0.014335	0.499506	9°52′
0.667709	0.334281	0.014359	0.499505	9°53′
0.667712	0.334284	0.014384	0.499503	9°54′
0.667716	0.334287	0.014408	0.499501	9°55′
0.667719	0.334290	0.014432	0.499500	9°56′
0.667723	0.334294	0.014456	0.499498	9°57′
0.667726	0.334297	0.014480	0.499496	9°58′
0.667730	0.334300	0.014504	0.499494	9°59′
0.667734	0.334303	0.014529	0.499493	10°00′
0.667737	0.334307	0.014553	0.499491	10°01′
0.667741	0.334310	0.014577	0.499489	10°02′
0.667744	0.334313	0.014601	0.499488	10°03′
0.667748	0.334316	0.014625	0.499486	10°04′
0.667751	0.334320	0.014649	0.499484	10°05′
0.667755	0.334323	0.014674	0.499483	10°06′
0.667759	0.334326	0.014698	0.499481	10°07′
0.667762	0.334330	0.014722	0.499479	10°08′
0.667766	0.334333	0.014746	0.499477	10°09′
0.667769	0.334336	0.014770	0.499476	10°10′
0.667773	0.334339	0.014794	0.499474	10°11′
0.667777	0.334343	0.014818	0.499472	10°12′
0.667780	0.334346	0.014843	0.499471	10°13′
0.667784	0.334349	0.014867	0.499469	10°14′
0.667788	0.334353	0.014891	0.499467	10°15′
0.667791	0.334356	0.014915	0.499465	10°16′
0.667795	0.334359	0.014939	0.499464	10°17′
0.667799	0.334363	0.014963	0.499462	10°18′
0.667802	0.334366	0.014988	0.499460	10°19′
0.667806	0.334369	0.015012	0.499458	10°20′
0.667810	0.334373	0.015036	0.499457	10°21′
0.667813	0.334376	0.015060	0.499455	10°22′
0.667817	0.334379	0.015084	0.499453	10°23′
0.667821	0.334383	0.015108	0.499451	10°24′
0.667825	0.334386	0.015132	0.499450	10°25′
0.667828	0.334390	0.015157	0.499448	10°26′
0.667832	0.334393	0.015181	0.499446	10°27′
0.667836	0.334396	0.015205	0.499444	10°28′
0.667839	0.334400	0.015229	0.499443	10°29′
0.667843	0.334403	0.015253	0.499441	10°30′
0.667847	0.334407	0.015277	0.499439	10°31′
0.667851	0.334410	0.015302	0.499437	10°32′
0.667855	0.334413	0.015326	0.499435	10°33′
0.667858	0.334417	0.015350	0.499434	10°34′
0.667862	0.334420	0.015374	0.499432	10°35′
0.667866	0.334424	0.015398	0.499430	10°36′
0.667870	0.334427	0.015422	0.499428	10°37′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
10°38′	3°32′36″	0.998470	0.996561	0.061710
10°39′	3°32′56″	0.998465	0.996550	0.061806
10°40′	3°33′16″	0.998460	0.996540	0.061903
10°41′	3°33′36″	0.998456	0.996529	0.061999
10°42′	3°33′56″	0.998451	0.996518	0.062095
10°43′	3°34′16″	0.998446	0.996507	0.062191
10°44′	3°34′36″	0.998441	0.996496	0.062288
10°45′	3°34′56″	0.998436	0.996485	0.062384
10°46′	3°35′16″	0.998431	0.996475	0.062480
10°47′	3°35′36″	0.998427	0.996464	0.062576
10°48′	3°35′56″	0.998422	0.996453	0.062672
10°49′	3°36′16″	0.998417	0.996442	0.062769
10°50′	3°36′36″	0.998412	0.996431	0.062865
10°51′	3°36′56″	0.998407	0.996420	0.062961
10°52′	3°37′16″	0.998402	0.996409	0.063057
10°53′	3°37′36″	0.998397	0.996398	0.063154
10°54′	3°37′56″	0.998392	0.996387	0.063250
10°55′	3°38′16″	0.998387	0.996376	0.063346
10°56′	3°38′36″	0.998383	0.996365	0.063442
10°57′	3°38′56″	0.998378	0.996354	0.063538
10°58′	3°39′16″	0.998373	0.996343	0.063635
10°59′	3°39′36″	0.998368	0.996332	0.063731
11°00′	3°39′56″	0.998363	0.996320	0.063827
11°01′	3°40′16″	0.998358	0.996309	0.063923
11°02′	3°40′36″	0.998353	0.996298	0.064020
11°03′	3°40′56″	0.998348	0.996287	0.064116
11°04′	3°41′16″	0.998343	0.996276	0.064212
11°05′	3°41′36″	0.998338	0.996265	0.064308
11°06′	3°41′56″	0.998333	0.996253	0.064404
11°07′	3°42′16″	0.998328	0.996242	0.064500
11°08′	3°42′36″	0.998323	0.996231	0.064597
11°09′	3°42′56″	0.998318	0.996220	0.064693
11°10′	3°43′16″	0.998313	0.996208	0.064789
11°11′	3°43′36″	0.998308	0.996197	0.064885
11°12′	3°43′56″	0.998303	0.996186	0.064981
11°13′	3°44′16″	0.998298	0.996174	0.065077
11°14′	3°44′36″	0.998293	0.996163	0.065174
11°15′	3°44′56″	0.998288	0.996152	0.065270
11°16′	3°45′16″	0.998282	0.996140	0.065366
11°17′	3°45′36″	0.998277	0.996129	0.065462
11°18′	3°45′56″	0.998272	0.996117	0.065558
11°19′	3°46′15″	0.998267	0.996106	0.065654
11°20′	3°46′35″	0.998262	0.996094	0.065751
11°21′	3°46′55″	0.998257	0.996083	0.065847
11°22′	3°47′15″	0.998252	0.996071	0.065943
11°23′	3°47′35″	0.998247	0.996060	0.066039
11°24′	3°47′55″	0.998242	0.996048	0.066135
11°25′	3°48′15″	0.998236	0.996037	0.066231
11°26′	3°48′35″	0.998231	0.996025	0.066327
11°27′	3°48′55″	0.998226	0.996014	0.066424
11°28′	3°49′15″	0.998221	0.996002	0.066520
11°29′	3°49′35″	0.998216	0.995991	0.066616
11°30′	3°49′55″	0.998211	0.995979	0.066712

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.667873	0.334431	0.015446	0.499427	10°38′
0.667877	0.334434	0.015471	0.499425	10°39′
0.667881	0.334438	0.015495	0.499423	10°40′
0.667885	0.334441	0.015519	0.499421	10°41′
0.667889	0.334444	0.015543	0.499419	10°42′
0.667892	0.334448	0.015567	0.499418	10°43′
0.667896	0.334451	0.015591	0.499416	10°44′
0.667900	0.334455	0.015616	0.499414	10°45′
0.667904	0.334458	0.015640	0.499412	10°46′
0.667908	0.334462	0.015664	0.499410	10°47′
0.667912	0.334465	0.015688	0.499408	10°48′
0.667916	0.334469	0.015712	0.499407	10°49′
0.667919	0.334472	0.015736	0.499405	10°50′
0.667923	0.334476	0.015760	0.499403	10°51′
0.667927	0.334479	0.015785	0.499401	10°52′
0.667931	0.334483	0.015809	0.499399	10°53′
0.667935	0.334487	0.015833	0.499397	10°54′
0.667939	0.334490	0.015857	0.499396	10°55′
0.667943	0.334494	0.015881	0.499394	10°56′
0.667947	0.334497	0.015905	0.499382	10°57′
0.667951	0.334501	0.015929	0.499390	10°58′
0.667954	0.334504	0.015954	0.499388	10°59′
0.667958	0.334508	0.015978	0.499386	11°00′
0.667962	0.334511	0.016002	0.499385	11°01′
0.667966	0.334515	0.016026	0.499383	11°02′
0.667970	0.334519	0.016050	0.499381	11°03′
0.667974	0.334522	0.016074	0.499379	11°04′
0.667978	0.334526	0.016098	0.499377	11°05′
0.667982	0.334529	0.016123	0.499375	11°06′
0.667986	0.334533	0.016147	0.499373	11°07′
0.667990	0.334537	0.016171	0.499371	11°08′
0.667994	0.334540	0.016195	0.499370	11°09′
0.667998	0.334544	0.016219	0.499368	11°10′
0.668002	0.334548	0.016243	0.499366	11°11′
0.668006	0.334551	0.016268	0.499364	11°12′
0.668010	0.334555	0.016292	0.499362	11°13′
0.668014	0.334558	0.016316	0.499360	11°14′
0.668018	0.334562	0.016340	0.499358	11°15′
0.668022	0.334566	0.016364	0.499356	11°16′
0.668026	0.334569	0.016388	0.499354	11°17′
0.668030	0.334573	0.016412	0.499352	11°18′
0.668034	0.334577	0.016436	0.499351	11°19′
0.668038	0.334580	0.016461	0.499349	11°20′
0.668042	0.334584	0.016485	0.499347	11°21′
0.668046	0.334588	0.016509	0.499345	11°22′
0.668050	0.334592	0.016533	0.499343	11°23′
0.668054	0.334595	0.016557	0.499341	11°24′
0.668058	0.334599	0.016581	0.499339	11°25′
0.668063	0.334603	0.016605	0.499337	11°26′
0.668067	0.334606	0.016630	0.499335	11°27′
0.668071	0.334610	0.016654	0.499333	11°28′
0.668075	0.334614	0.016678	0.499331	11°29′
0.668079	0.334618	0.016702	0.499329	11°30′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
11°31′	3°50′15″	0.998205	0.995967	0.066808
11°32′	3°50′35″	0.998200	0.995956	0.066904
11°33′	3°50′55″	0.998195	0.995944	0.067000
11°34′	3°51′15″	0.998190	0.995932	0.067096
11°35′	3°51′35″	0.998185	0.995921	0.067193
11°36′	3°51′55″	0.998179	0.995909	0.067289
11°37′	3°52′15″	0.998174	0.995897	0.067385
11°38′	3°52′35″	0.998169	0.995885	0.067481
11°39′	3°52′55″	0.998164	0.995874	0.067577
11°40′	3°53′15″	0.998158	0.995862	0.067673
11°41′	3°53′35″	0.998153	0.995850	0.067769
11°42′	3°53′55″	0.998148	0.995838	0.067865
11°43′	3°54′15″	0.998143	0.995826	0.067961
11°44′	3°54′35″	0.998137	0.995814	0.068057
11°45′	3°54′55″	0.998132	0.995803	0.068154
11°46′	3°55′15″	0.998127	0.995791	0.068250
11°47′	3°55′35″	0.998121	0.995779	0.068346
11°48′	3°55′55″	0.998116	0.995767	0.068442
11°49′	3°56′15″	0.998111	0.995755	0.068538
11°50′	3°56′35″	0.998106	0.995743	0.068634
11°51′	3°56′55″	0.998100	0.995731	0.068730
11°52′	3°57′15″	0.998095	0.995719	0.068826
11°53′	3°57′35″	0.998089	0.995707	0.068922
11°54′	3°57′55″	0.998084	0.995695	0.069018
11°55′	3°58′15″	0.998079	0.995683	0.069114
11°56′	3°58′35″	0.998073	0.995671	0.069210
11°57′	3°58′55″	0.998068	0.995659	0.069306
11°58′	3°59′15″	0.998063	0.995647	0.069402
11°59′	3°59′35″	0.998057	0.995635	0.069499
12°00′	3°59′55″	0.998052	0.995622	0.069595
12°01′	4°00′15″	0.998046	0.995610	0.069691
12°02′	4°00′35″	0.998041	0.995598	0.069787
12°03′	4°00′55″	0.998036	0.995586	0.069883
12°04′	4°01′15″	0.998030	0.995574	0.069979
12°05′	4°01′35″	0.998025	0.995562	0.070075
12°06′	4°01′55″	0.998019	0.995549	0.070171
12°07′	4°02′14″	0.998014	0.995537	0.070267
12°08′	4°02′34″	0.998008	0.995525	0.070363
12°09′	4°02′54″	0.998003	0.995513	0.070459
12°10′	4°03′14″	0.997997	0.995500	0.070555
12°11′	4°03′34″	0.997992	0.995488	0.070651
12°12′	4°03′54″	0.997986	0.995476	0.070747
12°13′	4°04′14″	0.997981	0.995463	0.070843
12°14′	4°04′34″	0.997975	0.995451	0.070939
12°15′	4°04′54″	0.997970	0.995438	0.071035
12°16′	4°05′14″	0.997964	0.995426	0.071131
12°17′	4°05′34″	0.997959	0.995414	0.071227
12°18′	4°05′54″	0.997953	0.995401	0.071323
12°19′	4°06′14″	0.997948	0.995389	0.071419
12°20′	4°06′34″	0.997942	0.995376	0.071515
12°21′	4°06′54″	0.997937	0.995364	0.071611
12°22′	4°07′14″	0.997931	0.995351	0.071707
12°23′	4°07′34″	0.997925	0.995339	0.071803

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.668083	0.334621	0.016726	0.499327	11°31′
0.668087	0.334625	0.016750	0.499325	11°32′
0.668091	0.334629	0.016774	0.499324	11°33′
0.668095	0.334633	0.016799	0.499322	11°34′
0.668100	0.334636	0.016823	0.499320	11°35′
0.668104	0.334640	0.016847	0.499318	11°36′
0.668108	0.334644	0.016871	0.499316	11°37′
0.668112	0.334648	0.016895	0.499314	11°38′
0.668116	0.334651	0.016919	0.499312	11°39′
0.668120	0.334655	0.016943	0.499310	11°40′
0.668124	0.334659	0.016967	0.499308	11°41′
0.668129	0.334663	0.016992	0.499306	11°42′
0.668133	0.334667	0.017016	0.499304	11°43′
0.668137	0.334670	0.017040	0.499302	11°44′
0.668141	0.334674	0.017064	0.499300	11°45′
0.668145	0.334678	0.017088	0.499298	11°46′
0.668150	0.334682	0.017112	0.499296	11°47′
0.668154	0.334686	0.017136	0.499294	11°48′
0.668158	0.334690	0.017161	0.499292	11°49′
0.668162	0.334693	0.017185	0.499290	11°50′
0.668167	0.334697	0.017209	0.499288	11°51′
0.668171	0.334701	0.017233	0.499286	11°52′
0.668175	0.334705	0.017257	0.499284	11°53′
0.668179	0.334709	0.017281	0.499282	11°54′
0.668184	0.334713	0.017305	0.499280	11°55′
0.668188	0.334717	0.017329	0.499278	11°56′
0.668192	0.334720	0.017354	0.499276	11°57′
0.668196	0.334724	0.017378	0.499274	11°58′
0.668201	0.334728	0.017402	0.499272	11°59′
0.668205	0.334732	0.017426	0.499270	12°00′
0.668209	0.334736	0.017450	0.499268	12°01′
0.668214	0.334740	0.017474	0.499266	12°02′
0.668218	0.334744	0.017498	0.499264	12°03′
0.668222	0.334748	0.017522	0.499262	12°04′
0.668226	0.334752	0.017547	0.499260	12°05′
0.668231	0.334756	0.017571	0.499258	12°06′
0.668235	0.334760	0.017595	0.499256	12°07′
0.668239	0.334764	0.017619	0.499254	12°08′
0.668244	0.334768	0.017643	0.499252	12°09′
0.668248	0.334771	0.017667	0.499249	12°10′
0.668252	0.334775	0.017691	0.499247	12°11′
0.668257	0.334779	0.017715	0.499245	12°12′
0.668261	0.334783	0.017740	0.499243	12°13′
0.668266	0.334787	0.017764	0.499241	12°14′
0.668270	0.334791	0.017788	0.499239	12°15′
0.668274	0.334795	0.017812	0.499237	12°16′
0.668279	0.334799	0.017836	0.499235	12°17′
0.668283	0.334803	0.017860	0.499233	12°18′
0.668288	0.334807	0.017884	0.499231	12°19′
0.668292	0.234811	0.017908	0.499229	12°20′
0.668296	0.334815	0.017933	0.499227	12°21′
0.668301	0.334819	0.017957	0.499225	12°22′
0.668305	0.334823	0.017981	0.499223	12°23′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
12°24′	4°07′54″	0.997920	0.995326	0.071899
12°25′	4°08′14″	0.997914	0.995314	0.071995
12°26′	4°08′34″	0.997909	0.995301	0.072091
12°27′	4°08′54″	0.997903	0.995289	0.072187
12°28′	4°09′14″	0.997897	0.995276	0.072283
12°29′	4°09′34″	0.997892	0.995263	0.072379
12°30′	4°09′54″	0.997886	0.995251	0.072475
12°31′	4°10′14″	0.997881	0.995238	0.072571
12°32′	4°10′34″	0.997875	0.995226	0.072667
12°33′	4°10′54″	0.997869	0.995213	0.072763
12°34′	4°11′14″	0.997864	0.995200	0.072859
12°35′	4°11′34″	0.997858	0.995187	0.072955
12°36′	4°11′54″	0.997852	0.995175	0.073051
12°37′	4°12′14″	0.997847	0.995162	0.073147
12°38′	4°12′34″	0.997841	0.995149	0.073243
12°39′	4°12′54″	0.997835	0.995136	0.073339
12°40′	4°13′14″	0.997829	0.995124	0.073435
12°41′	4°13′34″	0.997824	0.995111	0.073531
12°42′	4°13′54″	0.997818	0.995098	0.073627
12°43′	4°14′14″	0.997812	0.995085	0.073723
12°44′	4°14′34″	0.997807	0.995072	0.073818
12°45′	4°14′54″	0.997801	0.995059	0.073914
12°46′	4°15′14″	0.997795	0.995047	0.074010
12°47′	4°15′33″	0.997789	0.995034	0.074106
12°48′	4°15′53″	0.997784	0.995021	0.074202
12°49′	4°16′13″	0.997778	0.995008	0.074298
12°50′	4°16′33″	0.997772	0.994995	0.074394
12°51′	4°16′53″	0.997766	0.994982	0.074490
12°52′	4°17′13″	0.997760	0.994969	0.074586
12°53′	4°17′33″	0.997755	0.994956	0.074682
12°54′	4°17′53″	0.997749	0.994943	0.074778
12°55′	4°18′13″	0.997743	0.994930	0.074874
12°56′	4°18′33″	0.997737	0.994917	0.074970
12°57′	4°18′53″	0.997731	0.994904	0.075065
12°58′	4°19′13″	0.997726	0.994890	0.075161
12°59′	4°19′33″	0.997720	0.994877	0.075257
13°00′	4°19′53″	0.997714	0.994864	0.075353
13°01′	4°20′13″	0.997708	0.994851	0.075449
13°02′	4°20′33″	0.997702	0.994838	0.075545
13°03′	4°20′53″	0.997696	0.994825	0.075641
13°04′	4°21′13″	0.997690	0.994812	0.075737
13°05′	4°21′33″	0.997684	0.994798	0.075833
13°06′	4°21′53″	0.997679	0.994785	0.075929
13°07′	4°22′13″	0.997673	0.994772	0.076024
13°08′	4°22′33″	0.997667	0.994759	0.076120
13°09′	4°22′53″	0.997661	0.994745	0.076216
13°10′	4°23′13″	0.997655	0.994732	0.076312
13°11′	4°23′33″	0.997649	0.994719	0.076408
13°12′	4°23′53″	0.997643	0.994705	0.076504
13°13′	4°24′13″	0.997637	0.994692	0.076600
13°14′	4°24′33″	0.997631	0.994679	0.076696
13°15′	4°24′53″	0.997625	0.994665	0.076791
13°16′	4°25′13″	0.997619	0.994652	0.076887

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.668310	0.334827	0.018005	0.499220	12°24′
0.668314	0.334831	0.018029	0.499218	12°25′
0.668319	0.334836	0.018053	0.499216	12°26′
0.668323	0.334840	0.018077	0.499214	12°27′
0.668327	0.334844	0.018101	0.499212	12°28′
0.668332	0.334848	0.018125	0.499210	12°29′
0.668336	0.334852	0.018150	0.499208	12°30′
0.668341	0.334856	0.018174	0.499206	12°31′
0.668345	0.334860	0.018198	0.499204	12°32′
0.668350	0.334864	0.018222	0.499201	12°33′
0.668354	0.334868	0.018246	0.499199	12°34′
0.668359	0.334872	0.018270	0.499197	12°35′
0.668363	0.334876	0.018294	0.499195	12°36′
0.668368	0.334880	0.018318	0.499193	12°37′
0.668372	0.334884	0.018343	0.499191	12°38′
0.668377	0.334889	0.018367	0.499189	12°39′
0.668381	0.334893	0.018391	0.499187	12°40′
0.668386	0.334897	0.018415	0.499184	12°41′
0.668390	0.334901	0.018439	0.499182	12°42′
0.668395	0.334905	0.018463	0.499180	12°43′
0.668400	0.334909	0.018487	0.499178	12°44′
0.668404	0.334913	0.018511	0.499176	12°45′
0.668409	0.334918	0.018535	0.499174	12°46′
0.668413	0.334922	0.018560	0.499172	12°47′
0.668418	0.334926	0.018584	0.499169	12°48′
0.668422	0.334930	0.018608	0.499167	12°49′
0.668427	0.334934	0.018632	0.499165	12°50′
0.668432	0.334938	0.018656	0.499163	12°51′
0.668436	0.334943	0.018680	0.499161	12°52′
0.668441	0.334947	0.018704	0.499159	12°53′
0.668445	0.334951	0.018728	0.499156	12°54′
0.668450	0.334955	0.018752	0.499154	12°55′
0.668455	0.334959	0.018777	0.499152	12°56′
0.668459	0.334964	0.018801	0.499150	12°57′
0.668464	0.334968	0.018825	0.499148	12°58′
0.668469	0.334972	0.018849	0.499145	12°59′
0.668473	0.334976	0.018873	0.499143	13°00′
0.668478	0.334981	0.018897	0.499141	13°01′
0.668483	0.334985	0.018921	0.499139	13°02′
0.668487	0.334989	0.018945	0.499137	13°03′
0.668492	0.334993	0.018969	0.499134	13°04′
0.668497	0.334998	0.018994	0.499132	13°05′
0.668501	0.335002	0.019018	0.499130	13°06′
0.668506	0.335006	0.019042	0.499128	13°07′
0.668511	0.335010	0.019066	0.499126	13°08′
0.668515	0.335015	0.019090	0.499123	13°09′
0.668520	0.335019	0.019114	0.499121	13°10′
0.668525	0.335023	0.019138	0.499119	13°11′
0.668530	0.335028	0.019162	0.499117	13°12′
0.668534	0.335032	0.019186	0.499115	13°13′
0.668539	0.335036	0.019210	0.499112	13°14′
0.668544	0.335040	0.019235	0.499110	13°15′
0.668549	0.335045	0.019259	0.499108	13°16′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
13°17′	4°25′33″	0.997613	0.994638	0.076983
13°18′	4°25′53″	0.997607	0.994625	0.077079
13°19′	4°26′13″	0.997601	0.994612	0.077175
13°20′	4°26′33″	0.997595	0.994598	0.077271
13°21′	4°26′53″	0.997589	0.994585	0.077366
13°22′	4°27′13″	0.997583	0.994571	0.077462
13°23′	4°27′33″	0.997577	0.994558	0.077558
13°24′	4°27′53″	0.997571	0.994544	0.077654
13°25′	4°28′12″	0.997565	0.994531	0.077750
13°26′	4°28′32″	0.997559	0.994517	0.077846
13°27′	4°28′52″	0.997553	0.994503	0.077941
13°28′	4°29′12″	0.997547	0.994490	0.078037
13°29′	4°29′32″	0.997541	0.994476	0.078133
13°30′	4°29′52″	0.997535	0.994463	0.078229
13°31′	4°30′12″	0.997529	0.994449	0.078325
13°32′	4°30′32″	0.997523	0.994435	0.078420
13°33′	4°30′52″	0.997516	0.994422	0.078516
13°34′	4°31′12″	0.997510	0.994408	0.078612
13°35′	4°31′32″	0.997504	0.994394	0.078708
13°36′	4°31′52″	0.997498	0.994380	0.078804
13°37′	4°32′12″	0.997492	0.994367	0.078899
13°38′	4°32′32″	0.997486	0.994353	0.078995
13°39′	4°32′52″	0.997480	0.994339	0.079091
13°40′	4°33′12″	0.997474	0.994325	0.079187
13°41′	4°33′32″	0.997467	0.994312	0.079283
13°42′	4°33′52″	0.997461	0.994298	0.079378
13°43′	4°34′12″	0.997455	0.994284	0.079474
13°44′	4°34′32″	0.997449	0.994270	0.079570
13°45′	4°34′52″	0.997443	0.994256	0.079666
13°46′	4°35′12″	0.997437	0.994242	0.079761
13°47′	4°35′32″	0.997430	0.994228	0.079857
13°48′	4°35′52″	0.997424	0.994214	0.079953
13°49′	4°36′12″	0.997418	0.994200	0.080049
13°50′	4°36′32″	0.997412	0.994187	0.080144
13°51′	4°36′52″	0.997405	0.994173	0.080240
13°52′	4°37′12″	0.997399	0.994159	0.080336
13°53′	4°37′32″	0.997393	0.994145	0.080432
13°54′	4°37′52″	0.997387	0.994131	0.080527
13°55′	4°38′12″	0.997380	0.994116	0.080623
13°56′	4°38′32″	0.997374	0.994102	0.080719
13°57′	4°38′52″	0.997368	0.994088	0.080815
13°58′	4°39′12″	0.997362	0.994074	0.080910
13°59′	4°39′31″	0.997355	0.994060	0.081006
14°00′	4°39′51″	0.997349	0.994046	0.081102
14°01′	4°40′11″	0.997343	0.994032	0.081198
14°02′	4°40′31″	0.997336	0.994018	0.081293
14°03′	4°40′51″	0.997330	0.994003	0.081389
14°04′	4°41′11″	0.997324	0.993989	0.081485
14°05′	4°41′31″	0.997317	0.993975	0.081581
14°06′	4°41′51″	0.997311	0.993961	0.081676
14°07′	4°42′11″	0.997305	0.993947	0.081772
14°08′	4°42′31″	0.997298	0.993932	0.081868
14°09′	4°42′51″	0.997292	0.993918	0.081963

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.668553	0.335049	0.019283	0.499106	13°17′
0.668558	0.335053	0.019307	0.499103	13°18′
0.668563	0.335058	0.019331	0.499101	13°19′
0.668568	0.335062	0.019355	0.499099	13°20′
0.668572	0.335066	0.019379	0.499097	13°21′
0.668577	0.335071	0.019403	0.499094	13°22′
0.668582	0.335075	0.019427	0.499092	13°23′
0.668587	0.335080	0.019451	0.499090	13°24′
0.668592	0.335084	0.019476	0.499088	13°25′
0.668596	0.335088	0.019500	0.499085	13°26′
0.668601	0.335093	0.019524	0.499083	13°27′
0.668606	0.335097	0.019548	0.499081	13°28′
0.668611	0.335101	0.019572	0.499078	13°29′
0.668616	0.335106	0.019596	0.499076	13°30′
0.668621	0.335110	0.019620	0.499074	13°31′
0.668625	0.335115	0.019644	0.499072	13°32′
0.668630	0.335119	0.019668	0.499069	13°33′
0.668635	0.335124	0.019692	0.499067	13°34′
0.668640	0.335128	0.019717	0.499065	13°35′
0.668645	0.335132	0.019741	0.499062	13°36′
0.668650	0.335137	0.019765	0.499060	13°37′
0.668655	0.335141	0.019789	0.499058	13°38′
0.668659	0.335146	0.019813	0.499056	13°39′
0.668664	0.335150	0.019837	0.499053	13°40′
0.668669	0.335155	0.019861	0.499051	13°41′
0.668674	0.335159	0.019885	0.499049	13°42′
0.668679	0.335164	0.019909	0.499046	13°43′
0.668684	0.335168	0.019933	0.499044	13°44′
0.668689	0.335173	0.019957	0.499042	13°45′
0.668694	0.335177	0.019982	0.499039	13°46′
0.668699	0.335182	0.020006	0.499037	13°47′
0.668704	0.335186	0.020030	0.499035	13°48′
0.668709	0.335191	0.020054	0.499032	13°49′
0.668714	0.335195	0.020078	0.499030	13°50′
0.668719	0.335200	0.020102	0.499028	13°51′
0.668724	0.335204	0.020126	0.499025	13°52′
0.668729	0.335209	0.020150	0.499023	13°53′
0.668734	0.335213	0.020174	0.499021	13°54′
0.668739	0.335218	0.020198	0.499018	13°55′
0.668744	0.335222	0.020222	0.499016	13°56′
0.668749	0.335227	0.020246	0.499014	13°57′
0.668754	0.335231	0.020271	0.499011	13°58′
0.668759	0.335236	0.020295	0.499009	13°59′
0.668764	0.335240	0.020319	0.499007	14°00′
0.668769	0.335245	0.020343	0.499004	14°01′
0.668774	0.335250	0.020367	0.499002	14°02′
0.668779	0.335254	0.020391	0.499000	14°03′
0.668784	0.335259	0.020415	0.498997	14°04′
0.668789	0.335263	0.020439	0.498995	14°05′
0.668794	0.335268	0.020463	0.498992	14°06′
0.668799	0.335273	0.020487	0.498990	14°07′
0.668804	0.335277	0.020511	0.498988	14°08′
0.668809	0.335282	0.020536	0.498985	14°09′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
14°10′	4°43′11″	0.997286	0.993904	0.082059
14°11′	4°43′31″	0.997279	0.993889	0.082155
14°12′	4°43′51″	0.997273	0.993875	0.082250
14°13′	4°44′11″	0.997266	0.993861	0.082346
14°14′	4°44′31″	0.997260	0.993846	0.082442
14°15′	4°44′51″	0.997254	0.993832	0.082538
14°16′	4°45′11″	0.997247	0.993818	0.082633
14°17′	4°45′31″	0.997241	0.993803	0.082729
14°18′	4°45′51″	0.997234	0.993789	0.082825
14°19′	4°46′11″	0.997228	0.993774	0.082920
14°20′	4°46′31″	0.997221	0.993760	0.083016
14°21′	4°46′51″	0.997215	0.993745	0.083112
14°22′	4°47′11″	0.997208	0.993731	0.083207
14°23′	4°47′31″	0.997202	0.993716	0.083303
14°24′	4°47′51″	0.997195	0.993702	0.083399
14°25′	4°48′11″	0.997189	0.993687	0.083494
14°26′	4°48′31″	0.997182	0.993673	0.083590
14°27′	4°48′51″	0.997176	0.993658	0.083685
14°28′	4°49′11″	0.997169	0.993644	0.083781
14°29′	4°49′31″	0.997163	0.993629	0.083877
14°30′	4°49′51″	0.997156	0.993614	0.083972
14°31′	4°50′10″	0.997150	0.993600	0.084068
14°32′	4°50′30″	0.997143	0.993585	0.084164
14°33′	4°50′50″	0.997137	0.993570	0.084259
14°34′	4°51′10″	0.997130	0.993556	0.084355
14°35′	4°51′30″	0.997124	0.993541	0.084451
14°36′	4°51′50″	0.997117	0.993526	0.084546
14°37′	4°52′10″	0.997111	0.993512	0.084642
14°38′	4°52′30″	0.997104	0.993497	0.084737
14°39′	4°52′50″	0.997097	0.993482	0.084833
14°40′	4°53′10″	0.997091	0.993467	0.084929
14°41′	4°53′30″	0.997084	0.993452	0.085024
14°42′	4°53′50″	0.997077	0.993438	0.085120
14°43′	4°54′10″	0.997071	0.993423	0.085215
14°44′	4°54′30″	0.997064	0.993408	0.085311
14°45′	4°54′50″	0.997058	0.993393	0.085407
14°46′	4°55′10″	0.997051	0.993378	0.085502
14°47′	4°55′30″	0.997044	0.993363	0.085598
14°48′	4°55′50″	0.997038	0.993348	0.085693
14°49′	4°56′10″	0.997031	0.993333	0.085789
14°50′	4°56′30″	0.997024	0.993318	0.085884
14°51′	4°56′50″	0.997018	0.993303	0.085980
14°52′	4°57′10″	0.997011	0.993288	0.086076
14°53′	4°57′30″	0.997004	0.993273	0.086171
14°54′	4°57′50″	0.996998	0.993258	0.086267
14°55′	4°58′10″	0.996991	0.993243	0.086362
14°56′	4°58′30″	0.996984	0.993228	0.086458
14°57′	4°58′50″	0.996977	0.993213	0.086553
14°58′	4°59′10″	0.996971	0.993198	0.086649
14°59′	4°59′30″	0.996964	0.993183	0.086744
15°00′	4°59′49″	0.996957	0.993168	0.086840
15°01′	5°00′09″	0.996950	0.993153	0.086936
15°02′	5°00′29″	0.996944	0.993138	0.087031

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.668814	0.335286	0.020560	0.498983	14°10′
0.668819	0.335291	0.020584	0.498980	14°11′
0.668824	0.335296	0.020608	0.498978	14°12′
0.668829	0.335300	0.020632	0.498976	14°13′
0.668834	0.335305	0.020656	0.498973	14°14′
0.668840	0.335310	0.020680	0.498971	14°15′
0.668845	0.335314	0.020704	0.498968	14°16′
0.668850	0.335319	0.020728	0.498966	14°17′
0.668855	0.335324	0.020752	0.498964	14°18′
0.668860	0.335328	0.020776	0.498961	14°19′
0.668865	0.335333	0.020800	0.498959	14°20′
0.668870	0.335338	0.020825	0.498956	14°21′
0.668876	0.335342	0.020849	0.498954	14°22′
0.668881	0.335347	0.020873	0.498952	14°23′
0.668886	0.335352	0.020897	0.498949	14°24′
0.668891	0.335356	0.020921	0.498947	14°25′
0.668896	0.335361	0.020945	0.498944	14°26′
0.668901	0.335366	0.020969	0.498942	14°27′
0.668907	0.335371	0.020993	0.498939	14°28′
0.668912	0.335375	0.021017	0.498937	14°29′
0.668917	0.335380	0.021041	0.498935	14°30′
0.668922	0.335385	0.021065	0.498932	14°31′
0.668927	0.335390	0.021089	0.498930	14°32′
0.668933	0.335394	0.021113	0.498927	14°33′
0.668938	0.335399	0.021137	0.498925	14°34′
0.668943	0.335404	0.021162	0.498922	14°35′
0.668948	0.335409	0.021186	0.498920	14°36′
0.668954	0.335413	0.021210	0.498917	14°37′
0.668959	0.335418	0.021234	0.498915	14°38′
0.668964	0.335423	0.021258	0.498912	14°39′
0.668969	0.335428	0.021282	0.498910	14°40′
0.668975	0.335432	0.021306	0.498907	14°41′
0.668980	0.335437	0.021330	0.498905	14°42′
0.668985	0.335442	0.021354	0.498902	14°43′
0.668990	0.335447	0.021378	0.498900	14°44′
0.668996	0.335452	0.021402	0.498898	14°45′
0.669001	0.335457	0.021426	0.498895	14°46′
0.669006	0.335461	0.021450	0.498893	14°47′
0.669012	0.335466	0.021474	0.498890	14°48′
0.669017	0.335471	0.021499	0.498888	14°49′
0.669022	0.335476	0.021523	0.498885	14°50′
0.669028	0.335481	0.021547	0.498883	14°51′
0.669033	0.335486	0.021571	0.498880	14°52′
0.669038	0.335490	0.021595	0.498878	14°53′
0.669044	0.335495	0.021619	0.498875	14°54′
0.669049	0.335500	0.021643	0.498873	14°55′
0.669054	0.335505	0.021667	0.498870	14°56′
0.669060	0.335510	0.021691	0.498867	14°57′
0.669065	0.335515	0.021715	0.498865	14°58′
0.669071	0.335520	0.021739	0.498862	14°59′
0.669076	0.335525	0.021763	0.498860	15°00′
0.669081	0.335530	0.021787	0.498857	15°01′
0.669087	0.335534	0.021811	0.498855	15°02′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
15°03′	5°00′49″	0.996937	0.993122	0.087127
15°04′	5°01′09″	0.996930	0.993107	0.087222
15°05′	5°01′29″	0.996923	0.993092	0.087318
15°06′	5°01′49″	0.996916	0.993077	0.087413
15°07′	5°02′09″	0.996910	0.993061	0.087509
15°08′	5°02′29″	0.996903	0.993046	0.087604
15°09′	5°02′49″	0.996896	0.993031	0.087700
15°10′	5°03′09″	0.996889	0.993016	0.087795
15°11′	5°03′29″	0.996882	0.993000	0.087891
15°12′	5°03′49″	0.996876	0.992985	0.087986
15°13′	5°04′09″	0.996869	0.992970	0.088082
15°14′	5°04′29″	0.996862	0.992954	0.088177
15°15′	5°04′49″	0.996855	0.992939	0.088273
15°16′	5°05′09″	0.996848	0.992924	0.088368
15°17′	5°05′29″	0.996841	0.992908	0.088464
15°18′	5°05′49″	0.996834	0.992893	0.088559
15°19′	5°06′09″	0.996827	0.992877	0.088655
15°20′	5°06′29″	0.996821	0.992862	0.088750
15°21′	5°06′49″	0.996814	0.992846	0.088846
15°22′	5°07′09″	0.996807	0.992831	0.088941
15°23′	5°07′29″	0.996800	0.992815	0.089037
15°24′	5°07′49″	0.996793	0.992800	0.089132
15°25′	5°08′09″	0.996786	0.992784	0.089228
15°26′	5°08′29″	0.996779	0.992769	0.089323
15°27′	5°08′49″	0.996772	0.992753	0.089419
15°28′	5°09′09″	0.996765	0.992738	0.089514
15°29′	5°09′28″	0.996758	0.992722	0.089610
15°30′	5°09′48″	0.996751	0.992706	0.089705
15°31′	5°10′08″	0.996744	0.992691	0.089800
15°32′	5°10′28″	0.996737	0.992675	0.089896
15°33′	5°10′48″	0.996730	0.992659	0.089991
15°34′	5°11′08″	0.996723	0.992644	0.090087
15°35′	5°11′28″	0.996716	0.992628	0.090182
15°36′	5°11′48″	0.996709	0.992612	0.090278
15°37′	5°12′08″	0.996702	0.992596	0.090373
15°38′	5°12′28″	0.996695	0.992581	0.090468
15°39′	5°12′48″	0.996688	0.992565	0.090564
15°40′	5°13′08″	0.996681	0.992549	0.090659
15°41′	5°13′28″	0.996674	0.992533	0.090755
15°42′	5°13′48″	0.996667	0.992518	0.090850
15°43′	5°14′08″	0.996660	0.992502	0.090945
15°44′	5°14′28″	0.996653	0.992486	0.091041
15°45′	5°14′48″	0.996646	0.992470	0.091136
15°46′	5°15′08″	0.996639	0.992454	0.091232
15°47′	5°15′28″	0.996631	0.992438	0.091327
15°48′	5°15′48″	0.996624	0.992422	0.091422
15°49′	5°16′08″	0.996617	0.992406	0.091518
15°50′	5°16′28″	0.996610	0.992390	0.091613
15°51′	5°16′48″	0.996603	0.992374	0.091709
15°52′	5°17′08″	0.996596	0.992358	0.091804
15°53′	5°17′28″	0.996589	0.992342	0.091899
15°54′	5°17′47″	0.996582	0.992326	0.091995
15°55′	5°18′07″	0.996574	0.992310	0.092090

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.669092	0.335539	0.021835	0.498852	15°03′
0.669098	0.335544	0.021860	0.498850	15°04′
0.669103	0.335549	0.021884	0.498847	15°05′
0.669108	0.335554	0.021908	0.498845	15°06′
0.669114	0.335559	0.021932	0.498842	15°07′
0.669119	0.335564	0.021956	0.498840	15°08′
0.669125	0.335569	0.021980	0.498837	15°09′
0.669130	0.335574	0.022004	0.498834	15°10′
0.669136	0.335579	0.022028	0.498832	15°11′
0.669141	0.335584	0.022052	0.498829	15°12′
0.669146	0.335589	0.022076	0.498827	15°13′
0.669152	0.335594	0.022100	0.498824	15°14′
0.669157	0.335599	0.022124	0.498822	15°15′
0.669163	0.335604	0.022148	0.498819	15°16′
0.669168	0.335609	0.022172	0.498817	15°17′
0.669174	0.335614	0.022196	0.498814	15°18′
0.669179	0.335619	0.022220	0.498811	15°19′
0.669185	0.335624	0.022244	0.498809	15°20′
0.669190	0.335629	0.022269	0.498806	15°21′
0.669196	0.335634	0.022293	0.498804	15°22′
0.669201	0.335639	0.022317	0.498801	15°23′
0.669207	0.335644	0.022341	0.498798	15°24′
0.669213	0.335649	0.022365	0.498796	15°25′
0.669218	0.335654	0.022389	0.498793	15°26′
0.669224	0.335659	0.022413	0.498791	15°27′
0.669229	0.335664	0.022437	0.498788	15°28′
0.669235	0.335669	0.022461	0.498785	15°29′
0.669240	0.335674	0.022485	0.498783	15°30′
0.669246	0.335679	0.022509	0.498780	15°31′
0.669251	0.335684	0.022533	0.498778	15°32′
0.669257	0.335690	0.022557	0.498775	15°33′
0.669263	0.335695	0.022581	0.498772	15°34′
0.669268	0.335700	0.022605	0.498770	15°35′
0.669274	0.335705	0.022629	0.498767	15°36′
0.669280	0.335710	0.022653	0.498764	15°37′
0.669285	0.335715	0.022677	0.498762	15°38′
0.669291	0.335720	0.022701	0.498759	15°39′
0.669296	0.335725	0.022725	0.498757	15°40′
0.669302	0.335730	0.022749	0.498754	15°41′
0.669308	0.335736	0.022774	0.498751	15°42′
0.669313	0.335741	0.022798	0.498749	15°43′
0.669319	0.335746	0.022822	0.498746	15°44′
0.669325	0.335751	0.022846	0.498743	15°45′
0.669330	0.335756	0.022870	0.498741	15°46′
0.669336	0.335761	0.022894	0.498738	15°47′
0.669342	0.335767	0.022918	0.498735	15°48′
0.669347	0.335772	0.022942	0.498733	15°49′
0.669353	0.335777	0.022966	0.498730	15°50′
0.669359	0.335782	0.022990	0.498727	15°51′
0.669364	0.335787	0.023014	0.498725	15°52′
0.669370	0.335792	0.023038	0.498722	15°53′
0.669376	0.335798	0.023062	0.498719	15°54′
0.669382	0.335803	0.023086	0.498717	15°55′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
15°56′	5°18′27″	0.996567	0.992294	0.092185
15°57′	5°18′47″	0.996560	0.992278	0.092281
15°58′	5°19′07″	0.996553	0.992262	0.092376
15°59′	5°19′27″	0.996546	0.992246	0.092472
16°00′	5°19′47″	0.996538	0.992230	0.092567
16°06′	5°21′47″	0.996495	0.992133	0.093139
16°12′	5°23′47″	0.996451	0.992035	0.093711
16°18′	5°25′47″	0.996408	0.991937	0.094283
16°24′	5°27′46″	0.996363	0.991838	0.094854
16°30′	5°29′46″	0.996319	0.991739	0.095426
16°36′	5°31′46″	0.996274	0.991639	0.095997
16°42′	5°33′46″	0.996229	0.991538	0.096569
16°48′	5°35′45″	0.996184	0.991437	0.097140
16°54′	5°37′45″	0.996139	0.991335	0.097711
17°00′	5°39′45″	0.996093	0.991232	0.098282
17°06′	5°41′44″	0.996047	0.991129	0.098853
17°12′	5°43′44″	0.996000	0.991026	0.099423
17°18′	5°45′44″	0.995954	0.990921	0.099994
17°24′	5°47′44″	0.995907	0.990817	0.100564
17°30′	5°49′43″	0.995860	0.990711	0.101134
17°36′	5°51′43″	0.995813	0.990605	0.101705
17°42′	5°53′43″	0.995765	0.990499	0.102275
17°48′	5°55′42″	0.995717	0.990392	0.102844
17°54′	5°57′42″	0.995669	0.990284	0.103414
18°00′	5°59′42″	0.995620	0.990175	0.103984
18°06′	6°01′42″	0.995572	0.990066	0.104553
18°12′	6°03′41″	0.995523	0.989957	0.105123
18°18′	6°05′41″	0.995473	0.989847	0.105692
18°24′	6°07′41″	0.995424	0.989736	0.106261
18°30′	6°09′40″	0.995374	0.989625	0.106830
18°36′	6°11′40″	0.995324	0.989513	0.107399
18°42′	6°13′40″	0.995274	0.989400	0.107967
18°48′	6°15′39″	0.995223	0.989287	0.108536
18°54′	6°17′39″	0.995172	0.989173	0.109104
19°00′	6°19′39″	0.995121	0.989059	0.109672
19°06′	6°21′38″	0.995070	0.988944	0.110240
19°12′	6°23′38″	0.995018	0.988829	0.110808
19°18′	6°25′38″	0.994966	0.988713	0.111376
19°24′	6°27′37″	0.994914	0.988596	0.111944
19°30′	6°29′37″	0.994861	0.988479	0.112511
19°36′	6°31′37″	0.994809	0.988361	0.113079
19°42′	6°33′36″	0.994756	0.988243	0.113646
19°48′	6°35′36″	0.994702	0.988124	0.114213
19°54′	6°37′36″	0.994649	0.988004	0.114780
20°00′	6°39′35″	0.994595	0.987884	0.115346
20°06′	6°41′35″	0.994541	0.987763	0.115913
20°12′	6°43′34″	0.994487	0.987642	0.116480
20°18′	6°45′34″	0.994432	0.987520	0.117046
20°24′	6°47′34″	0.994377	0.987397	0.117612
20°30′	6°49′33″	0.994322	0.987274	0.118178
20°36′	6°51′33″	0.994267	0.987150	0.118744
20°42′	6°53′32″	0.994211	0.987026	0.119310
20°48′	6°55′32″	0.994155	0.986901	0.119875

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.669387	0.335808	0.023110	0.498714	15°56′
0.669393	0.335813	0.023134	0.498711	15°57′
0.669399	0.335819	0.023158	0.498709	15°58′
0.669405	0.335824	0.023182	0.498706	15°59′
0.669410	0.335829	0.023206	0.498703	16°00′
0.669445	0.335861	0.023351	0.498687	16°06′
0.669480	0.335892	0.023495	0.498671	16°12′
0.669515	0.335924	0.023639	0.498654	16°18′
0.669550	0.335956	0.023783	0.498638	16°24′
0.669586	0.335989	0.023927	0.498621	16°30′
0.669622	0.336021	0.024071	0.498604	16°36′
0.669658	0.336054	0.024216	0.498587	16°42′
0.669694	0.336087	0.024360	0.498571	16°48′
0.669730	0.336120	0.024504	0.498554	16°54′
0.669767	0.336154	0.024648	0.498536	17°00′
0.669804	0.336187	0.024792	0.498519	17°06′
0.669841	0.336221	0.024936	0.498502	17°12′
0.669878	0.336255	0.025080	0.498484	17°18′
0.669916	0.336289	0.025224	0.498467	17°24′
0.669954	0.336324	0.025368	0.498449	17°30′
0.669992	0.336358	0.025512	0.498432	17°36′
0.670030	0.336393	0.025656	0.498414	17°42′
0.670069	0.336428	0.025800	0.498396	17°48′
0.670107	0.336463	0.025944	0.498378	17°54′
0.670146	0.336499	0.026088	0.498360	18°00′
0.670185	0.336534	0.026232	0.498341	18°06′
0.670225	0.336570	0.026376	0.498323	18°12′
0.670264	0.336606	0.026519	0.498305	18°18′
0.670304	0.336642	0.026663	0.498286	18°24′
0.670344	0.336679	0.026807	0.498267	18°30′
0.670384	0.336716	0.026951	0.498249	18°36′
0.670425	0.336752	0.027095	0.498230	18°42′
0.670466	0.336790	0.027239	0.498211	18°48′
0.670507	0.336827	0.027382	0.498192	18°54′
0.670548	0.336864	0.027526	0.498173	19°00′
0.670589	0.336902	0.027670	0.498154	19°06′
0.670631	0.336940	0.027814	0.498134	19°12′
0.670673	0.336978	0.027957	0.498115	19°18′
0.670715	0.337016	0.028101	0.498095	19°24′
0.670757	0.337055	0.028245	0.498076	19°30′
0.670800	0.337094	0.028388	0.498056	19°36′
0.670842	0.337133	0.028532	0.498036	19°42′
0.670885	0.337172	0.028675	0.498016	19°48′
0.670929	0.337211	0.028819	0.497996	19°54′
0.670972	0.337251	0.028963	0.497976	20°00′
0.671016	0.337290	0.029106	0.497956	20°06′
0.671060	0.337330	0.029250	0.497936	20°12′
0.671104	0.337371	0.029393	0.497915	20°18′
0.671148	0.337411	0.029537	0.497895	20°24′
0.671193	0.337452	0.029680	0.497874	20°30′
0.671237	0.337492	0.029824	0.497853	20°36′
0.671282	0.337533	0.029967	0.497832	20°42′
0.671328	0.337575	0.030110	0.497812	20°48′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
20°54′	6°57′32″	0.994099	0.986776	0.120440
21°00′	6°59′31″	0.994042	0.986650	0.121006
21°06′	7°01′31″	0.993985	0.986523	0.121571
21°12′	7°03′30″	0.993928	0.986396	0.122136
21°18′	7°05′30″	0.993871	0.986268	0.122700
21°24′	7°07′30″	0.993814	0.986140	0.123265
21°30′	7°09′29″	0.993756	0.986011	0.123829
21°36′	7°11′29″	0.993698	0.985881	0.124394
21°42′	7°13′28″	0.993639	0.985751	0.124958
21°48′	7°15′28″	0.993581	0.985620	0.125522
21°54′	7°17′27″	0.993522	0.985489	0.126086
22°00′	7°19′27″	0.993463	0.985357	0.126649
22°06′	7°21′26″	0.993403	0.985224	0.127213
22°12′	7°23′26″	0.993344	0.985091	0.127776
22°18′	7°25′26″	0.993284	0.984958	0.128339
22°24′	7°27′25″	0.993223	0.984823	0.128902
22°30′	7°29′25″	0.993163	0.984688	0.129465
22°36′	7°31′24″	0.993102	0.984553	0.130027
22°42′	7°33′24″	0.993041	0.984417	0.130590
22°48′	7°35′23″	0.992980	0.984280	0.131152
22°54′	7°37′23″	0.992918	0.984143	0.131714
23°00′	7°39′22″	0.992856	0.984006	0.132276
23°06′	7°41′22″	0.992794	0.983867	0.132838
23°12′	7°43′21″	0.992732	0.983728	0.133400
23°18′	7°45′21″	0.992669	0.983589	0.133961
23°24′	7°47′20″	0.992606	0.983449	0.134522
23°30′	7°49′20″	0.992543	0.983308	0.135083
23°36′	7°51′19″	0.992480	0.983167	0.135644
23°42′	7°53′19″	0.992416	0.983025	0.136205
23°48′	7°55′18″	0.992352	0.982883	0.136766
23°54′	7°57′18″	0.992288	0.982740	0.137326
24°00′	7°59′17″	0.992223	0.982596	0.137886
24°06′	8°01′16″	0.992159	0.982452	0.138446
24°12′	8°03′16″	0.992094	0.982307	0.139006
24°18′	8°05′15″	0.992028	0.982162	0.139566
24°24′	8°07′15″	0.991963	0.982016	0.140125
24°30′	8°09′14″	0.991897	0.981869	0.140684
24°36′	8°11′14″	0.991831	0.981722	0.141244
24°42′	8°13′13″	0.991765	0.981575	0.141802
24°48′	8°15′13″	0.991698	0.981427	0.142361
24°54′	8°17′12″	0.991631	0.981278	0.142920
25°00′	8°19′11″	0.991564	0.981128	0.143478
25°06′	8°21′11″	0.991497	0.980979	0.144036
25°12′	8°23′10″	0.991429	0.980828	0.144594
25°18′	8°25′10″	0.991361	0.980677	0.145152
25°24′	8°27′09″	0.991293	0.980525	0.145710
25°30′	8°29′08″	0.991224	0.980373	0.146267
25°36′	8°31′08″	0.991155	0.980220	0.146824
25°42′	8°33′07″	0.991086	0.980067	0.147381
25°48′	8°35′07″	0.991017	0.979913	0.147938
25°54′	8°37′06″	0.990948	0.979758	0.148495
26°00′	8°39′05″	0.990878	0.979603	0.149051
26°06′	8°41′05″	0.990808	0.979448	0.149608

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.671373	0.337616	0.030254	0.497791	20°54′
0.671419	0.337658	0.030397	0.497769	21°00′
0.671465	0.337700	0.030540	0.497748	21°06′
0.671511	0.337742	0.030684	0.497727	21°12′
0.671558	0.337784	0.030827	0.497705	21°18′
0.671604	0.337826	0.030970	0.497684	21°24′
0.671651	0.337869	0.031114	0.497662	21°30′
0.671698	0.337912	0.031257	0.497641	21°36′
0.671746	0.337955	0.031400	0.497619	21°42′
0.671793	0.337999	0.031543	0.497597	21°48′
0.671841	0.338042	0.031687	0.497575	21°54′
0.671889	0.338086	0.031830	0.497553	22°00′
0.671937	0.338130	0.031973	0.497531	22°06′
0.671986	0.338174	0.032116	0.497508	22°12′
0.672034	0.338218	0.032259	0.497486	22°18′
0.672083	0.338263	0.032402	0.497463	22°24′
0.672133	0.338308	0.032545	0.497441	22°30′
0.672182	0.338353	0.032688	0.497418	22°36′
0.672232	0.338398	0.032831	0.497395	22°42′
0.672282	0.338444	0.032974	0.497372	22°48′
0.672332	0.338489	0.033117	0.497349	22°54′
0.672382	0.338535	0.033260	0.497326	23°00′
0.672433	0.338581	0.033403	0.497303	23°06′
0.672484	0.338628	0.033546	0.497280	23°12′
0.672535	0.338674	0.033689	0.497256	23°18′
0.672586	0.338721	0.033832	0.497233	23°24′
0.672637	0.338768	0.033975	0.497209	23°30′
0.672689	0.338815	0.034118	0.497186	23°36′
0.672741	0.338863	0.034260	0.497162	23°42′
0.672793	0.338910	0.034403	0.497138	23°48′
0.672846	0.338958	0.034546	0.497114	23°54′
0.672899	0.339006	0.034689	0.497090	24°00′
0.672952	0.339054	0.034831	0.497066	24°06′
0.673005	0.339103	0.034974	0.497041	24°12′
0.673058	0.339151	0.035117	0.497017	24°18′
0.673112	0.339200	0.035259	0.496993	24°24′
0.673166	0.339249	0.035402	0.496968	24°30′
0.673220	0.339299	0.035545	0.496943	24°36′
0.673274	0.339348	0.035687	0.496919	24°42′
0.673329	0.339398	0.035830	0.496894	24°48′
0.673384	0.339448	0.035972	0.496869	24°54′
0.673439	0.339498	0.036115	0.496844	25°00′
0.673494	0.339549	0.036257	0.496818	25°06′
0.673549	0.339599	0.036400	0.496793	25°12′
0.673605	0.339650	0.036542	0.496768	25°18′
0.673661	0.339701	0.036685	0.496742	25°24′
0.673718	0.339752	0.036827	0.496717	25°30′
0.673774	0.339804	0.036969	0.496691	25°36′
0.673831	0.339856	0.037112	0.496665	25°42′
0.673888	0.339908	0.037254	0.496640	25°48′
0.673945	0.339960	0.037396	0.496614	25°54′
0.674002	0.340012	0.037539	0.496588	26°00′
0.674060	0.340065	0.037681	0.496561	26°06′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
26°12′	8°43′04″	0.990737	0.979291	0.150164
26°18′	8°45′03″	0.990667	0.979134	0.150720
26°24′	8°47′03″	0.990596	0.978977	0.151275
26°30′	8°49′02″	0.990525	0.978819	0.151831
26°36′	8°51′01″	0.990453	0.978660	0.152386
26°42′	8°53′01″	0.990382	0.978501	0.152941
26°48′	8°55′00″	0.990310	0.978342	0.153496
26°54′	8°56′59″	0.990238	0.978181	0.154051
27°00′	8°58′59″	0.990165	0.978021	0.154606
27°06′	9°00′58″	0.990092	0.977859	0.155160
27°12′	9°02′57″	0.990019	0.977697	0.155714
27°18′	9°04′57″	0.989946	0.977535	0.156268
27°24′	9°06′56″	0.989873	0.977371	0.156822
27°30′	9°08′55″	0.989799	0.977208	0.157375
27°36′	9°10′55″	0.989725	0.977043	0.157928
27°42′	9°12′54″	0.989650	0.976879	0.158482
27°48′	9°14′53″	0.989576	0.976713	0.159034
27°54′	9°16′52″	0.989501	0.976547	0.159587
28°00′	9°18′52″	0.989426	0.976381	0.160140
28°06′	9°20′51″	0.989351	0.976213	0.160692
28°12′	9°22′50″	0.989275	0.976046	0.161244
28°18′	9°24′49″	0.989199	0.975877	0.161796
28°24′	9°26′49″	0.989123	0.975709	0.162347
28°30′	9°28′48″	0.989046	0.975539	0.162899
28°36′	9°30′47″	0.988970	0.975369	0.163450
28°42′	9°32′46″	0.988893	0.975199	0.164001
28°48′	9°34′46″	0.988816	0.975028	0.164552
28°54′	9°36′45″	0.988738	0.974856	0.165103
29°00′	9°38′44″	0.988660	0.974684	0.165653
29°06′	9°40′43″	0.988582	0.974511	0.166203
29°12′	9°42′42″	0.988504	0.974338	0.166753
29°18′	9°44′42″	0.988425	0.974164	0.167303
29°24′	9°46′41″	0.988347	0.973989	0.167852
29°30′	9°48′40″	0.988268	0.973814	0.168402
29°36′	9°50′39″	0.988188	0.973638	0.168951
29°42′	9°52′38″	0.988109	0.973462	0.169499
29°48′	9°54′38″	0.988029	0.973285	0.170048
29°54′	9°56′37″	0.987949	0.973108	0.170597
30°00′	9°58′36″	0.987868	0.972930	0.171145
30°06′	10°00′35″	0.987788	0.972752	0.171693
30°12′	10°02′34″	0.987707	0.972573	0.172241
30°18′	10°04′33″	0.987625	0.972393	0.172788
30°24′	10°06′32″	0.987544	0.972213	0.173335
30°30′	10°08′32″	0.987462	0.972032	0.173882
30°36′	10°10′31″	0.987380	0.971851	0.174429
30°42′	10°12′30″	0.987298	0.971669	0.174976
30°48′	10°14′29″	0.987216	0.971487	0.175522
30°54′	10°16′28″	0.987133	0.971304	0.176069
31°00′	10°18′27″	0.987050	0.971120	0.176614
31°06′	10°20′26″	0.986967	0.970936	0.177160
31°12′	10°22′25″	0.986883	0.970752	0.177706
31°18′	10°24′24″	0.986799	0.970566	0.178251
31°24′	10°26′23″	0.986715	0.970381	0.178796

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.674118	0.340118	0.037823	0.496535	26°12′
0.674176	0.340171	0.037965	0.496509	26°18′
0.674235	0.340224	0.038107	0.496482	26°24′
0.674293	0.340277	0.038250	0.496456	26°30′
0.674352	0.340331	0.038392	0.496429	26°36′
0.674411	0.340385	0.038534	0.496402	26°42′
0.674471	0.340439	0.038676	0.496376	26°48′
0.674530	0.340493	0.038818	0.496349	26°54′
0.674590	0.340548	0.038960	0.496322	27°00′
0.674650	0.340603	0.039102	0.496295	27°06′
0.674710	0.340658	0.039244	0.496267	27°12′
0.674771	0.340713	0.039386	0.496240	27°18′
0.674832	0.340769	0.039528	0.496213	27°24′
0.674893	0.340824	0.039670	0.496185	27°30′
0.674954	0.340880	0.039812	0.496157	27°36′
0.675016	0.340936	0.039953	0.496130	27°42′
0.675077	0.340993	0.040095	0.496102	27°48′
0.675140	0.341049	0.040237	0.496074	27°54′
0.675202	0.341106	0.040379	0.496046	28°00′
0.675264	0.341163	0.040520	0.496018	28°06′
0.675327	0.341220	0.040662	0.495990	28°12′
0.675390	0.341278	0.040804	0.495961	28°18′
0.675453	0.341336	0.040946	0.495933	28°24′
0.675517	0.341393	0.041087	0.495904	28°30′
0.675581	0.341452	0.041229	0.495876	28°36′
0.675645	0.341510	0.041370	0.495847	28°42′
0.675709	0.341569	0.041512	0.495818	28°48′
0.675773	0.341627	0.041653	0.495790	28°54′
0.675838	0.341686	0.041795	0.495761	29°00′
0.675903	0.341746	0.041936	0.495731	29°06′
0.675968	0.341805	0.042078	0.495702	29°12′
0.676034	0.341865	0.042219	0.495673	29°18′
0.676099	0.341925	0.042361	0.495644	29°24′
0.676165	0.341985	0.042502	0.495614	29°30′
0.676231	0.342046	0.042643	0.495585	29°36′
0.676298	0.342106	0.042785	0.495555	29°42′
0.676365	0.342167	0.042926	0.495525	29°48′
0.676432	0.342228	0.043067	0.495495	29°54′
0.676499	0.342290	0.043208	0.495465	30°00′
0.676566	0.342351	0.043350	0.495435	30°06′
0.676634	0.342413	0.043491	0.495405	30°12′
0.676702	0.342475	0.043632	0.495375	30°18′
0.676770	0.342537	0.043773	0.495345	30°24′
0.676838	0.342600	0.043914	0.495314	30°30′
0.676907	0.342662	0.044055	0.495284	30°36′
0.676976	0.342725	0.044196	0.495253	30°42′
0.677045	0.342788	0.044337	0.495222	30°48′
0.677115	0.342852	0.044478	0.495191	30°54′
0.677184	0.342915	0.044619	0.495161	31°00′
0.677254	0.342979	0.044760	0.495130	31°06′
0.677325	0.343043	0.044901	0.495098	31°12′
0.677395	0.343108	0.045042	0.495067	31°18′
0.677466	0.343172	0.045183	0.495036	31°24′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
31°30′	10°28′23″	0.986631	0.970194	0.179341
31°36′	10°30′22″	0.986546	0.970007	0.179885
31°42′	10°32′21″	0.986461	0.969820	0.180430
31°48′	10°34′20″	0.986376	0.969632	0.180974
31°54′	10°36′19″	0.986291	0.969444	0.181518
32°00′	10°38′18″	0.986205	0.969254	0.182061
32°06′	10°40′17″	0.986119	0.969065	0.182605
32°12′	10°42′16″	0.986033	0.968875	0.183148
32°18′	10°44′15″	0.985947	0.968684	0.183691
32°24′	10°46′14″	0.985860	0.968492	0.184234
32°30′	10°48′13″	0.985773	0.968301	0.184776
32°36′	10°50′12″	0.985686	0.968108	0.185318
32°42′	10°52′11″	0.985598	0.967915	0.185860
32°48′	10°54′10″	0.985510	0.967722	0.186402
32°54′	10°56′09″	0.985422	0.967527	0.186944
33°00′	10°58′08″	0.985334	0.967333	0.187485
33°06′	11°00′07″	0.985245	0.967138	0.188026
33°12′	11°02′06″	0.985157	0.966942	0.188567
33°18′	11°04′05″	0.985068	0.966745	0.189107
33°24′	11°06′04″	0.984978	0.966549	0.189647
33°30′	11°08′03″	0.984889	0.966351	0.190188
33°36′	11°10′02″	0.984799	0.966153	0.190727
33°42′	11°12′01″	0.984709	0.965955	0.191267
33°48′	11°13′59″	0.984618	0.965755	0.191806
33°54′	11°15′58″	0.984528	0.965556	0.192345
34°00′	11°17′57″	0.984437	0.965356	0.192884
34°06′	11°19′56″	0.984346	0.965155	0.193423
34°12′	11°21′55″	0.984254	0.964954	0.193961
34°18′	11°23′54″	0.984162	0.964752	0.194499
34°24′	11°25′53″	0.984071	0.964549	0.195037
34°30′	11°27′52″	0.983978	0.964346	0.195574
34°36′	11°29′51″	0.983886	0.964143	0.196112
34°42′	11°31′50″	0.983793	0.963939	0.196649
34°48′	11°33′48″	0.983700	0.963734	0.197186
34°54′	11°35′47″	0.983607	0.963529	0.197722
35°00′	11°37′46″	0.983513	0.963323	0.198258
35°06′	11°39′45″	0.983420	0.963117	0.198794
35°12′	11°41′44″	0.983326	0.962910	0.199330
35°18′	11°43′43″	0.983231	0.962703	0.199866
35°24′	11°45′41″	0.983137	0.962495	0.200401
35°30′	11°47′40″	0.983042	0.962287	0.200936
35°36′	11°49′39″	0.982947	0.962078	0.201471
35°42′	11°51′38″	0.982851	0.961868	0.202005
35°48′	11°53′37″	0.982756	0.961658	0.202539
35°54′	11°55′35″	0.982660	0.961448	0.203073
36°00′	11°57′34″	0.982564	0.961237	0.203607
36°06′	11°59′33″	0.982467	0.961025	0.204141
36°12′	12°01′32″	0.982371	0.960813	0.204674
36°18′	12°03′31″	0.982274	0.960600	0.205207
36°24′	12°05′29″	0.982177	0.960387	0.205739
36°30′	12°07′28″	0.982079	0.960173	0.206272
36°36′	12°09′27″	0.981982	0.959958	0.206804
36°42′	12°11′25″	0.981884	0.959743	0.207336

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.677537	0.343237	0.045323	0.495004	31°30′
0.677608	0.343302	0.045464	0.494973	31°36′
0.677679	0.343367	0.045605	0.494941	31°42′
0.677751	0.343433	0.045746	0.494910	31°48′
0.677823	0.343499	0.045886	0.494878	31°54′
0.677895	0.343564	0.046027	0.494846	32°00′
0.677968	0.343631	0.046168	0.494814	32°06′
0.678040	0.343697	0.046308	0.494782	32°12′
0.678113	0.343764	0.046449	0.494750	32°18′
0.678187	0.343831	0.046589	0.494718	32°24′
0.678260	0.343898	0.046730	0.494685	32°30′
0.678334	0.343965	0.046870	0.494653	32°36′
0.678408	0.344033	0.047011	0.494620	32°42′
0.678482	0.344100	0.047151	0.494587	32°48′
0.678557	0.344169	0.047292	0.494555	32°54′
0.678631	0.344237	0.047432	0.494522	33°00′
0.678706	0.344305	0.047572	0.494489	33°06′
0.678782	0.344374	0.047712	0.494456	33°12′
0.678857	0.344443	0.047853	0.494423	33°18′
0.678933	0.344512	0.047993	0.494390	33°24′
0.679009	0.344582	0.048133	0.494356	33°30′
0.679085	0.344652	0.048273	0.494323	33°36′
0.679162	0.344722	0.048413	0.494289	33°42′
0.679239	0.344792	0.048554	0.494256	33°48′
0.679316	0.344862	0.048694	0.494222	33°54′
0.679393	0.344933	0.048834	0.494188	34°00′
0.679471	0.345004	0.048974	0.494154	34°06′
0.679549	0.345075	0.049114	0.494120	34°12′
0.679627	0.345146	0.049254	0.494086	34°18′
0.679705	0.345218	0.049394	0.494052	34°24′
0.679784	0.345290	0.049533	0.494018	34°30′
0.679863	0.345362	0.049673	0.493983	34°36′
0.679942	0.345434	0.049813	0.493949	34°42′
0.680021	0.345507	0.049953	0.493914	34°48′
0.680101	0.345580	0.050093	0.493880	34°54′
0.680181	0.345653	0.050232	0.493845	35°00′
0.680261	0.345726	0.050372	0.493810	35°06′
0.680342	0.345800	0.050512	0.493775	35°12′
0.680423	0.345874	0.050651	0.493740	35°18′
0.680504	0.345948	0.050791	0.493705	35°24′
0.680585	0.346022	0.050930	0.493670	35°30′
0.680666	0.346097	0.051070	0.493634	35°36′
0.680748	0.346171	0.051209	0.493599	35°42′
0.680830	0.346246	0.051349	0.493563	35°48′
0.680913	0.346322	0.051488	0.493528	35°54′
0.680995	0.346397	0.051628	0.493492	36°00′
0.681078	0.346473	0.051767	0.493456	36°06′
0.681161	0.346549	0.051906	0.493420	36°12′
0.681245	0.346625	0.052046	0.493384	36°18′
0.681328	0.346702	0.052185	0.493348	36°24′
0.681412	0.346779	0.052324	0.493312	36°30′
0.681497	0.346856	0.052463	0.493276	36°36′
0.681581	0.346933	0.052603	0.493239	36°42′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
36°48′	12°13′24″	0.981785	0.959528	0.207867
36°54′	12°15′23″	0.981687	0.959312	0.208399
37°00′	12°17′22″	0.981588	0.959095	0.208930
37°06′	12°19′20″	0.981489	0.958878	0.209461
37°12′	12°21′19″	0.981390	0.958661	0.209991
37°18′	12°23′18″	0.981290	0.958442	0.210521
37°24′	12°25′16″	0.981191	0.958224	0.211051
37°30′	12°27′15″	0.981091	0.958004	0.211581
37°36′	12°29′14″	0.980990	0.957785	0.212110
37°42′	12°31′12″	0.980890	0.957564	0.212640
37°48′	12°33′11″	0.980789	0.957343	0.213169
37°54′	12°35′10″	0.980688	0.957122	0.213697
38°00′	12°37′08″	0.980587	0.956900	0.214225
38°06′	12°39′07″	0.980485	0.956677	0.214754
38°12′	12°41′06″	0.980383	0.956454	0.215281
38°18′	12°43′04″	0.980281	0.956231	0.215809
38°24′	12°45′03″	0.980179	0.956007	0.216336
38°30′	12°47′01″	0.980076	0.955782	0.216863
38°36′	12°49′00″	0.979973	0.955557	0.217390
38°42′	12°50′59″	0.979870	0.955331	0.217916
38°48′	12°52′57″	0.979767	0.955105	0.218442
38°54′	12°54′56″	0.979663	0.954878	0.218968
39°00′	12°56′54″	0.979559	0.954651	0.219494
39°06′	12°58′53″	0.979455	0.954423	0.220019
39°12′	13°00′51″	0.979350	0.954195	0.220544
39°18′	13°02′50″	0.979246	0.953966	0.221069
39°24′	13°04′49″	0.979141	0.953736	0.221593
39°30′	13°06′47″	0.979036	0.953506	0.222117
39°36′	13°08′46″	0.978930	0.953276	0.222641
39°42′	13°10′44″	0.978824	0.953045	0.223165
39°48′	13°12′43″	0.978718	0.952813	0.223688
39°54′	13°14′41″	0.978612	0.952581	0.224211
40°00′	13°16′40″	0.978506	0.952349	0.224734
40°06′	13°18′38″	0.978399	0.952116	0.225256
40°12′	13°20′37″	0.978292	0.951882	0.225778
40°18′	13°22′35″	0.978185	0.951648	0.226300
40°24′	13°24′33″	0.978077	0.951413	0.226822
40°30′	13°26′32″	0.977969	0.951178	0.227343
40°36′	13°28′30″	0.977861	0.950942	0.227864
40°42′	13°30′29″	0.977753	0.950706	0.228385
40°48′	13°32′27″	0.977644	0.950469	0.228905
40°54′	13°34′26″	0.977535	0.950231	0.229425
41°00′	13°36′24″	0.977426	0.949993	0.229945
41°06′	13°38′22″	0.977317	0.949755	0.230464
41°12′	13°40′21″	0.977207	0.949516	0.230984
41°18′	13°42′19″	0.977098	0.949277	0.231502
41°24′	13°44′18″	0.976987	0.949037	0.232021
41°30′	13°46′16″	0.976877	0.948796	0.232539
41°36′	13°48′14″	0.976766	0.948555	0.233057
41°42′	13°50′13″	0.976656	0.948314	0.233575
41°48′	13°52′11″	0.976544	0.948071	0.234093
41°54′	13°54′09″	0.976433	0.947829	0.234610
42°00′	13°56′08″	0.976321	0.947586	0.235126

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.681666	0.347010	0.052742	0.493203	36°48′
0.681751	0.347088	0.052881	0.493166	36°54′
0.681836	0.347166	0.053020	0.493130	37°00′
0.681922	0.347244	0.053159	0.493093	37°06′
0.682007	0.347323	0.053298	0.493056	37°12′
0.682094	0.347402	0.053437	0.493019	37°18′
0.682180	0.347481	0.053576	0.492982	37°24′
0.682267	0.347560	0.053715	0.492945	37°30′
0.682353	0.347639	0.053853	0.492908	37°36′
0.682441	0.347719	0.053992	0.492870	37°42′
0.682528	0.347799	0.054131	0.492833	37°48′
0.682616	0.347879	0.054270	0.492795	37°54′
0.682704	0.347960	0.054409	0.492758	38°00′
0.682792	0.348041	0.054547	0.492720	38°06′
0.682881	0.348122	0.054686	0.492682	38°12′
0.682969	0.348203	0.054824	0.492644	38°18′
0.683059	0.348284	0.054963	0.492606	38°24′
0.683148	0.348366	0.055102	0.492568	38°30′
0.683238	0.348448	0.055240	0.492530	38°36′
0.683327	0.348531	0.055379	0.492492	38°42′
0.683418	0.348613	0.055517	0.492454	38°48′
0.683508	0.348696	0.055655	0.492415	38°54′
0.683599	0.348779	0.055794	0.492377	39°00′
0.683690	0.348862	0.055932	0.492338	39°06′
0.683781	0.348946	0.056070	0.492299	39°12′
0.683873	0.349030	0.056209	0.492260	39°18′
0.683965	0.349114	0.056347	0.492221	39°24′
0.684057	0.349198	0.056485	0.492182	39°30′
0.684149	0.349283	0.056623	0.492143	39°36′
0.684242	0.349367	0.056761	0.492104	39°42′
0.684335	0.349452	0.056899	0.492065	39°48′
0.684428	0.349538	0.057037	0.492025	39°54′
0.684522	0.349624	0.057175	0.491986	40°00′
0.684615	0.349709	0.057313	0.491946	40°06′
0.684709	0.349796	0.057451	0.491907	40°12′
0.684804	0.349882	0.057589	0.491867	40°18′
0.684898	0.349969	0.057727	0.491827	40°24′
0.684993	0.350056	0.057865	0.491787	40°30′
0.685089	0.350143	0.058003	0.491747	40°36′
0.685184	0.350230	0.058140	0.491707	40°42′
0.685280	0.350318	0.058278	0.491667	40°48′
0.685376	0.350406	0.058416	0.491626	40°54′
0.685472	0.350494	0.058553	0.491586	41°00′
0.685569	0.350583	0.058691	0.491546	41°06′
0.685666	0.350671	0.058828	0.491505	41°12′
0.685763	0.350760	0.058966	0.491464	41°18′
0.685860	0.350850	0.059103	0.491423	41°24′
0.685958	0.350939	0.059241	0.491383	41°30′
0.686056	0.351029	0.059378	0.491342	41°36′
0.686155	0.351119	0.059516	0.491301	41°42′
0.686253	0.351209	0.059653	0.491259	41°48′
0.686352	0.351300	0.059790	0.491218	41°54′
0.686451	0.351391	0.059927	0.491177	42°00′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
42°06′	13°58′06″	0.976209	0.947342	0.235643
42°12′	14°00′04″	0.976097	0.947098	0.236159
42°18′	14°02′03″	0.975985	0.946853	0.236675
42°24′	14°04′01″	0.975872	0.946608	0.237191
42°30′	14°05′59″	0.975759	0.946362	0.237706
42°36′	14°07′58″	0.975646	0.946116	0.238221
42°42′	14°09′56″	0.975532	0.945869	0.238736
42°48′	14°11′54″	0.975419	0.945622	0.239250
42°54′	14°13′52″	0.975305	0.945374	0.239764
43°00′	14°15′51″	0.975191	0.945126	0.240278
43°06′	14°17′49″	0.975076	0.944877	0.240792
43°12′	14°19′47″	0.974961	0.944628	0.241305
43°18′	14°21′45″	0.974846	0.944378	0.241818
43°24′	14°23′43″	0.974731	0.944128	0.242330
43°30′	14°25′42″	0.974616	0.943877	0.242842
43°36′	14°27′40″	0.974500	0.943625	0.243354
43°42′	14°29′38″	0.974384	0.943373	0.243866
43°48′	14°31′36″	0.974268	0.943121	0.244377
43°54′	14°33′34″	0.974151	0.942868	0.244888
44°00′	14°35′33″	0.974034	0.942614	0.245399
44°06′	14°37′31″	0.973917	0.942360	0.245909
44°12′	14°39′29″	0.973800	0.942106	0.246419
44°18′	14°41′27″	0.973682	0.941851	0.246929
44°24′	14°43′25″	0.973564	0.941595	0.247438
44°30′	14°45′23″	0.973446	0.941339	0.247947
44°36′	14°47′21″	0.973328	0.941083	0.248456
44°42′	14°49′19″	0.973210	0.940826	0.248965
44°48′	14°51′18″	0.973091	0.940568	0.249473
44°54′	14°53′16″	0.972972	0.940310	0.249981
45°00′	14°55′14″	0.972852	0.940052	0.250488
45°06′	14°57′12″	0.972733	0.939793	0.250995
45°12′	14°59′10″	0.972613	0.939533	0.251502
45°18′	15°01′08″	0.972493	0.939273	0.252009
45°24′	15°03′06″	0.972372	0.939012	0.252515
45°30′	15°05′04″	0.972252	0.938751	0.253021
45°36′	15°07′02″	0.972131	0.938490	0.253527
45°42′	15°09′00″	0.972010	0.938227	0.254032
45°48′	15°10′58″	0.971888	0.937965	0.254537
45°54′	15°12′56″	0.971767	0.937702	0.255041
46°00′	15°14′54″	0.971645	0.937438	0.255546
46°06′	15°16′52″	0.971523	0.937174	0.256050
46°12′	15°18′50″	0.971400	0.936909	0.256553
46°18′	15°20′48″	0.971278	0.936644	0.257057
46°24′	15°22′46″	0.971155	0.936378	0.257560
46°30′	15°24′44″	0.971032	0.936112	0.258062
46°36′	15°26′42″	0.970908	0.935846	0.258565
46°42′	15°28′40″	0.970785	0.935578	0.259067
46°48′	15°30′38″	0.970661	0.935311	0.259568
46°54′	15°32′35″	0.970536	0.935043	0.260070
47°00′	15°34′33″	0.970412	0.934774	0.260570
47°06′	15°36′31″	0.970287	0.934505	0.261071
47°12′	15°38′29″	0.970162	0.934235	0.261572
47°18′	15°40′27″	0.970037	0.933965	0.262072

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.686551	0.351482	0.060065	0.491135	42°06′
0.686651	0.351574	0.060202	0.491094	42°12′
0.686751	0.351665	0.060339	0.491052	42°18′
0.686851	0.351757	0.060476	0.491010	42°24′
0.686952	0.351849	0.060613	0.490969	42°30′
0.687053	0.351942	0.060750	0.490927	42°36′
0.687154	0.352035	0.060887	0.490885	42°42′
0.687255	0.352128	0.061024	0.490843	42°48′
0.687357	0.352221	0.061161	0.490801	42°54′
0.687459	0.352315	0.061298	0.490758	43°00′
0.687562	0.352409	0.061435	0.490716	43°06′
0.687664	0.352503	0.061571	0.490673	43°12′
0.687767	0.352597	0.061708	0.490631	43°18′
0.687871	0.352692	0.061845	0.490588	43°24′
0.687974	0.352787	0.061982	0.490545	43°30′
0.688078	0.352882	0.062118	0.490503	43°36′
0.688182	0.352977	0.062255	0.490460	43°42′
0.688287	0.353073	0.062391	0.490417	43°48′
0.688391	0.353169	0.062528	0.490374	43°54′
0.688497	0.353265	0.062664	0.490330	44°00′
0.688602	0.353362	0.062801	0.490287	44°06′
0.688708	0.353459	0.062937	0.490244	44°12′
0.688813	0.353556	0.063073	0.490200	44°18′
0.688920	0.353654	0.063210	0.490157	44°24′
0.689026	0.353751	0.063346	0.490113	44°30′
0.689133	0.353849	0.063482	0.490069	44°36′
0.689240	0.353947	0.063618	0.490026	44°42′
0.689348	0.354046	0.063754	0.489982	44°48′
0.689455	0.354145	0.063891	0.489938	44°54′
0.689563	0.354244	0.064027	0.489894	45°00′
0.689672	0.354343	0.064163	0.489849	45°06′
0.689780	0.354443	0.064299	0.489805	45°12′
0.689889	0.354543	0.064435	0.489761	45°18′
0.689999	0.354643	0.064570	0.489716	45°24′
0.690108	0.354744	0.064706	0.489672	45°30′
0.690218	0.354844	0.064842	0.489627	45°36′
0.690328	0.354945	0.064978	0.489582	45°42′
0.690439	0.355047	0.065114	0.489537	45°48′
0.690549	0.355148	0.065249	0.489493	45°54′
0.690660	0.355250	0.065385	0.489447	46°00′
0.690772	0.355353	0.065521	0.489402	46°06′
0.690884	0.355455	0.065656	0.489357	46°12′
0.690995	0.355558	0.065792	0.489312	46°18′
0.691108	0.355661	0.065927	0.489267	46°24′
0.691220	0.355764	0.066063	0.489221	46°30′
0.691333	0.355868	0.066198	0.489175	46°36′
0.691447	0.355972	0.066333	0.489130	46°42′
0.691560	0.356076	0.066469	0.489084	46°48′
0.691674	0.356180	0.066604	0.489038	46°54′
0.691788	0.356285	0.066739	0.488992	47°00′
0.691903	0.356390	0.066874	0.488946	47°06′
0.692017	0.356496	0.067009	0.488900	47°12′
0.692132	0.356601	0.067145	0.488854	47°18′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
47°24′	15°42′25″	0.969912	0.933694	0.262571
47°30′	15°44′23″	0.969786	0.933423	0.263071
47°36′	15°46′21″	0.969660	0.933152	0.263570
47°42′	15°48′18″	0.969534	0.932879	0.264068
47°48′	15°50′16″	0.969407	0.932607	0.264566
47°54′	15°52′14″	0.969281	0.932334	0.265064
48°00′	15°54′12″	0.969154	0.932060	0.265562
48°06′	15°56′10″	0.969027	0.931786	0.266059
48°12′	15°58′07″	0.968899	0.931511	0.266556
48°18′	16°00′05″	0.968771	0.931236	0.267053
48°24′	16°02′03″	0.968643	0.930960	0.267549
48°30′	16°04′01″	0.968515	0.930684	0.268045
48°36′	16°05′58″	0.968387	0.930408	0.268541
48°42′	16°07′56″	0.968258	0.930131	0.269036
48°48′	16°09′54″	0.968129	0.929853	0.269531
48°54′	16°11′52″	0.968000	0.929575	0.270026
49°00′	16°13′49″	0.967870	0.929296	0.270520
49°06′	16°15′47″	0.967741	0.929017	0.271014
49°12′	16°17′45″	0.967611	0.928738	0.271507
49°18′	16°19′42″	0.967480	0.928458	0.272001
49°24′	16°21′40″	0.967350	0.928177	0.272493
49°30′	16°23′38″	0.967219	0.927896	0.272986
49°36′	16°25′35″	0.967088	0.927615	0.273478
49°42′	16°27′33″	0.966957	0.927333	0.273970
49°48′	16°29′31″	0.966825	0.927050	0.274461
49°54′	16°31′28″	0.966694	0.926767	0.274953
50°00′	16°33′26″	0.966562	0.926484	0.275443
50°15′	16°38′20″	0.966231	0.925773	0.276669
50°30′	16°43′14″	0.965898	0.925059	0.277892
50°45′	16°48′08″	0.965564	0.924343	0.279113
51°00′	16°53′01″	0.965228	0.923623	0.280332
51°15′	16°57′55″	0.964890	0.922900	0.281548
51°30′	17°02′49″	0.964552	0.922174	0.282763
51°45′	17°07′42″	0.964211	0.921445	0.283975
52°00′	17°12′36″	0.963869	0.920713	0.285185
52°15′	17°17′30″	0.963525	0.919979	0.286392
52°30′	17°22′23″	0.963180	0.919241	0.287598
52°45′	17°27′16″	0.962833	0.918500	0.288801
53°00′	17°32′10″	0.962485	0.917756	0.290001
53°15′	17°37′03″	0.962135	0.917010	0.291200
53°30′	17°41′56″	0.961784	0.916260	0.292396
53°45′	17°46′49″	0.961431	0.915508	0.293590
54°00′	17°51′42″	0.961076	0.914752	0.294781
54°15′	17°56′35″	0.960720	0.913994	0.295970
54°30′	18°01′28″	0.960363	0.913233	0.297157
54°45′	18°06′21″	0.960004	0.912469	0.298342
55°00′	18°11′13″	0.959643	0.911702	0.299524
55°15′	18°16′06″	0.959281	0.910932	0.300704
55°30′	18°20′59″	0.958917	0.910159	0.301881
55°45′	18°25′51″	0.958552	0.909383	0.303056
56°00′	18°30′44″	0.958185	0.908605	0.304229
56°15′	18°35′36″	0.957816	0.907823	0.305399
56°30′	18°40′28″	0.957446	0.907039	0.306567

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.692248	0.356707	0.067280	0.488808	47°24′
0.692363	0.356814	0.067415	0.488761	47°30′
0.692480	0.356920	0.067550	0.488715	47°36′
0.692596	0.357027	0.067685	0.488668	47°42′
0.692713	0.357134	0.067819	0.488622	47°48′
0.692829	0.357241	0.067954	0.488575	47°54′
0.692947	0.357349	0.068089	0.488528	48°00′
0.693064	0.357457	0.068224	0.488481	48°06′
0.693182	0.357565	0.068358	0.488434	48°12′
0.693300	0.357674	0.068493	0.488387	48°18′
0.693419	0.357783	0.068628	0.488340	48°24′
0.693538	0.357892	0.068762	0.488293	48°30′
0.693657	0.358002	0.068897	0.488245	48°36′
0.693777	0.358111	0.069031	0.488198	48°42′
0.693896	0.358221	0.069166	0.488150	48°48′
0.694017	0.358332	0.069300	0.488103	48°54′
0.694137	0.358442	0.069435	0.488055	49°00′
0.694258	0.358553	0.069569	0.488007	49°06′
0.694379	0.358665	0.069703	0.487959	49°12′
0.694500	0.358776	0.069837	0.487911	49°18′
0.694622	0.358888	0.069972	0.487863	49°24′
0.694744	0.359000	0.070106	0.487815	49°30′
0.694867	0.359113	0.070240	0.487767	49°36′
0.694989	0.359226	0.070374	0.487718	49°42′
0.695112	0.359339	0.070508	0.487670	49°48′
0.695236	0.359452	0.070642	0.487621	49°54′
0.695359	0.359566	0.070776	0.487573	50°00′
0.695670	0.359851	0.071110	0.487451	50°15′
0.695983	0.360139	0.071445	0.487328	50°30′
0.696298	0.360428	0.071779	0.487205	50°45′
0.696614	0.360720	0.072112	0.487082	51°00′
0.696933	0.361013	0.072446	0.486958	51°15′
0.697254	0.361308	0.072779	0.486833	51°30′
0.697578	0.361605	0.073112	0.486708	51°45′
0.697903	0.361905	0.073444	0.486582	52°00′
0.698230	0.362206	0.073777	0.486455	52°15′
0.698560	0.362509	0.074109	0.486329	52°30′
0.698891	0.362814	0.074440	0.486201	52°45′
0.699225	0.363121	0.074772	0.486073	53°00′
0.699561	0.363430	0.075103	0.485945	53°15′
0.699899	0.363741	0.075434	0.485815	53°30′
0.700239	0.364055	0.075764	0.485686	53°45′
0.700581	0.364370	0.076095	0.485556	54°00′
0.700926	0.364687	0.076425	0.485425	54°15′
0.701273	0.365006	0.076754	0.485294	54°30′
0.701622	0.365328	0.077083	0.485162	54°45′
0.701973	0.365651	0.077412	0.485029	55°00′
0.702326	0.365977	0.077741	0.484897	55°15′
0.702682	0.366305	0.078070	0.484763	55°30′
0.703040	0.366634	0.078398	0.484629	55°45′
0.703400	0.366966	0.078725	0.484495	56°00′
0.703762	0.367300	0.079053	0.484360	56°15′
0.704127	0.367637	0.079380	0.484224	56°30′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
56°45′	18°45′21″	0.957075	0.906252	0.307732
57°00′	18°50′13″	0.956702	0.905462	0.308895
57°15′	18°55′05″	0.956327	0.904670	0.310056
57°30′	18°59′57″	0.955951	0.903874	0.311214
57°45′	19°04′49″	0.955574	0.903076	0.312370
58°00′	19°09′41″	0.955194	0.902275	0.313523
58°15′	19°14′33″	0.954814	0.901471	0.314674
58°30′	19°19′24″	0.954432	0.900664	0.315822
58°45′	19°24′16″	0.954048	0.899855	0.316968
59°00′	19°29′08″	0.953663	0.899043	0.318111
59°15′	19°33′59″	0.953276	0.898228	0.319252
59°30′	19°38′51″	0.952888	0.897410	0.320390
59°45′	19°43′42″	0.952498	0.896590	0.321526
60°00′	19°48′33″	0.952106	0.895766	0.322659
60°15′	19°53′25″	0.951714	0.894941	0.323790
60°30′	19°58′16″	0.951319	0.894112	0.324918
60°45′	20°03′07″	0.950923	0.893281	0.326044
61°00′	20°07′58″	0.950526	0.892447	0.327167
61°15′	20°12′49″	0.950127	0.891610	0.328288
61°30′	20°17′40″	0.949727	0.890771	0.329406
61°45′	20°22′30″	0.949325	0.889929	0.330521
62°00′	20°27′21″	0.948921	0.889084	0.331634
62°15′	20°32′12″	0.948516	0.888237	0.332744
62°30′	20°37′02″	0.948110	0.887387	0.333852
62°45′	20°41′53″	0.947702	0.886534	0.334957
63°00′	20°46′43″	0.947292	0.885679	0.336059
63°15′	20°51′33″	0.946881	0.884821	0.337159
63°30′	20°56′23″	0.946469	0.883961	0.338256
63°45′	21°01′13″	0.946055	0.883098	0.339350
64°00′	21°06′04″	0.945640	0.882232	0.340442
64°15′	21°10′53″	0.945223	0.881364	0.341531
64°30′	21°15′43″	0.944804	0.880493	0.342618
64°45′	21°20′33″	0.944384	0.879620	0.343702
65°00′	21°25′23″	0.943963	0.878744	0.344783
65°15′	21°30′12″	0.943540	0.877865	0.345862
65°30′	21°35′02″	0.943116	0.876985	0.346937
65°45′	21°39′51″	0.942690	0.876101	0.348011
66°00′	21°44′41″	0.942263	0.875215	0.349081
66°15′	21°49′30″	0.941834	0.874326	0.350149
66°30′	21°54′19″	0.941403	0.873435	0.351214
66°45′	21°59′08″	0.940972	0.872542	0.352276
67°00′	22°03′57″	0.940538	0.871646	0.353335
67°15′	22°08′46″	0.940104	0.870748	0.354392
67°30′	22°13′35″	0.939668	0.869847	0.355446
67°45′	22°18′24″	0.939230	0.868943	0.356497
68°00′	22°23′13″	0.938791	0.868037	0.357546
68°15′	22°28′01″	0.938350	0.867129	0.358592
68°30′	22°32′50″	0.937908	0.866218	0.359635
68°45′	22°37′38″	0.937465	0.865305	0.360675
69°00′	22°42′26″	0.937020	0.864390	0.361712
69°15′	22°47′15″	0.936573	0.863472	0.362747
69°30′	22°52′03″	0.936125	0.862552	0.363779
69°45′	22°56′51″	0.935676	0.861629	0.364808

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.704494	0.367975	0.079707	0.484088	56°45′
0.704863	0.368316	0.080034	0.483951	57°00′
0.705235	0.368658	0.080360	0.483814	57°15′
0.705609	0.369003	0.080686	0.483676	57°30′
0.705985	0.369350	0.081011	0.483538	57°45′
0.706364	0.369700	0.081336	0.483399	58°00′
0.706745	0.370051	0.081661	0.483260	58°15′
0.707128	0.370405	0.081986	0.483120	58°30′
0.707514	0.370761	0.082310	0.482980	58°45′
0.707902	0.371119	0.082634	0.482839	59°00′
0.708293	0.371480	0.082958	0.482697	59°15′
0.708686	0.371842	0.083281	0.482555	59°30′
0.709081	0.372208	0.083604	0.482413	59°45′
0.709479	0.372575	0.083927	0.482270	60°00′
0.709879	0.372945	0.084249	0.482126	60°15′
0.710282	0.373317	0.084571	0.481982	60°30′
0.710687	0.373691	0.084893	0.481838	60°45′
0.711095	0.374068	0.085214	0.481692	61°00′
0.711505	0.374447	0.085535	0.481547	61°15′
0.711918	0.374828	0.085856	0.481401	61°30′
0.712333	0.375212	0.086176	0.481254	61°45′
0.712751	0.375599	0.086496	0.481107	62°00′
0.713172	0.375987	0.086816	0.480959	62°15′
0.713595	0.376378	0.087135	0.480811	62°30′
0.714020	0.376772	0.087454	0.480662	62°45′
0.714448	0.377168	0.087773	0.480513	63°00′
0.714879	0.377566	0.088091	0.480363	63°15′
0.715312	0.377967	0.088409	0.480213	63°30′
0.715748	0.378371	0.088727	0.480062	63°45′
0.716187	0.378777	0.089044	0.479911	64°00′
0.716628	0.379185	0.089361	0.479759	64°15′
0.717073	0.379596	0.089678	0.479607	64°30′
0.717519	0.380010	0.089994	0.479454	64°45′
0.717969	0.380426	0.090310	0.479301	65°00′
0.718421	0.380845	0.090625	0.479147	65°15′
0.718876	0.381266	0.090941	0.478993	65°30′
0.719333	0.381690	0.091255	0.478838	65°45′
0.719794	0.382117	0.091570	0.478682	66°00′
0.720257	0.382546	0.091884	0.478527	66°15′
0.720723	0.382978	0.092198	0.478370	66°30′
0.721192	0.383412	0.092511	0.478213	66°45′
0.721664	0.383850	0.092824	0.478056	67°00′
0.722138	0.384290	0.093137	0.477898	67°15′
0.722616	0.384732	0.093449	0.477740	67°30′
0.723096	0.385178	0.093761	0.477581	67°45′
0.723579	0.385626	0.094073	0.477422	68°00′
0.724065	0.386077	0.094384	0.477262	68°15′
0.724554	0.386531	0.094695	0.477102	68°30′
0.725046	0.386987	0.095005	0.476941	68°45′
0.725541	0.387446	0.095315	0.476779	69°00′
0.726039	0.387909	0.095625	0.476618	69°15′
0.726540	0.388374	0.095934	0.476455	69°30′
0.727044	0.388841	0.096243	0.476293	69°45′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
70°00′	23°01′39″	0.935225	0.860704	0.365834
70°15′	23°06′27″	0.934773	0.859776	0.366857
70°30′	23°11′14″	0.934319	0.858847	0.367878
70°45′	23°16′02″	0.933864	0.857915	0.368895
71°00′	23°20′50″	0.933407	0.856980	0.369910
71°15′	23°25′37″	0.932949	0.856043	0.370922
71°30′	23°30′25″	0.932489	0.855104	0.371931
71°45′	23°35′12″	0.932028	0.854163	0.372937
72°00′	23°39′59″	0.931566	0.853219	0.373941
72°15′	23°44′46″	0.931102	0.852273	0.374941
72°30′	23°49′33″	0.930637	0.851325	0.375939
72°45′	23°54′20″	0.930170	0.850375	0.376934
73°00′	23°59′07″	0.929702	0.849422	0.377926
73°15′	24°03′54″	0.929232	0.848467	0.378914
73°30′	24°08′40″	0.928761	0.847510	0.379900
73°45′	24°13′27″	0.928289	0.846550	0.380884
74°00′	24°18′13″	0.927815	0.845589	0.381864
74°15′	24°23′00″	0.927339	0.844625	0.382841
74°30′	24°27′46″	0.926863	0.843659	0.383815
74°45′	24°32′32″	0.926385	0.842691	0.384787
75°00′	24°37′18″	0.925905	0.841720	0.385755
75°15′	24°42′04″	0.925424	0.840748	0.386721
75°30′	24°46′50″	0.924941	0.839773	0.387683
75°45′	24°51′36″	0.924458	0.838796	0.388643
76°00′	24°56′21″	0.923972	0.837817	0.389599
76°15′	25°01′07″	0.923486	0.836836	0.390553
76°30′	25°05′52″	0.922998	0.835853	0.391503
76°45′	25°10′38″	0.922508	0.834867	0.392451
77°00′	25°15′23″	0.922017	0.833880	0.393396
77°15′	25°20′08″	0.921525	0.832890	0.394337
77°30′	25°24′53″	0.921031	0.831899	0.395276
77°45′	25°29′38″	0.920536	0.830905	0.396212
78°00′	25°34′23″	0.920039	0.829909	0.397144
78°15′	25°39′07″	0.919542	0.828911	0.398074
78°30′	25°43′52″	0.919042	0.827911	0.399000
78°45′	25°48′36″	0.918542	0.826910	0.399924
79°00′	25°53′21″	0.918039	0.825906	0.400844
79°15′	25°58′05″	0.917536	0.824900	0.401762
79°30′	26°02′49″	0.917031	0.823892	0.402676
79°45′	26°07′33″	0.916525	0.822882	0.403587
80°00′	26°12′17″	0.916017	0.821870	0.404496
80°15′	26°17′01″	0.915508	0.820856	0.405401
80°30′	26°21′45″	0.914998	0.819840	0.406303
80°45′	26°26′29″	0.914486	0.818823	0.407202
81°00′	26°31′12″	0.913973	0.817803	0.408098
81°15′	26°35′55″	0.913458	0.816781	0.408991
81°30′	26°40′39″	0.912942	0.815758	0.409881
81°45′	26°45′22″	0.912425	0.814732	0.410768
82°00′	26°50′05″	0.911906	0.813705	0.411651
82°15′	26°54′48″	0.911386	0.812676	0.412532
82°30′	26°59′31″	0.910865	0.811645	0.413409
82°45′	27°04′14″	0.910342	0.810612	0.414283
83°00′	27°08′56″	0.909818	0.809577	0.415154

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.727551	0.389312	0.096552	0.476129	70°00′
0.728061	0.389786	0.096860	0.475966	70°15′
0.728574	0.390263	0.097168	0.475801	70°30′
0.729091	0.390742	0.097476	0.475637	70°45′
0.729610	0.391225	0.097783	0.475472	71°00′
0.730132	0.391710	0.098090	0.475306	71°15′
0.730658	0.392199	0.098396	0.475140	71°30′
0.731187	0.392690	0.098702	0.474973	71°45′
0.731719	0.393185	0.099008	0.474806	72°00′
0.732254	0.393682	0.099313	0.474638	72°15′
0.732792	0.394183	0.099618	0.474470	72°30′
0.733334	0.394687	0.099922	0.474302	72°45′
0.733878	0.395194	0.100226	0.474133	73°00′
0.734427	0.395704	0.100530	0.473963	73°15′
0.734978	0.396217	0.100833	0.473793	73°30′
0.735533	0.396733	0.101136	0.473623	73°45′
0.736091	0.397253	0.101439	0.473452	74°00′
0.736652	0.397775	0.101741	0.473281	74°15′
0.737217	0.398301	0.102043	0.473109	74°30′
0.737786	0.398831	0.102344	0.472936	74°45′
0.738357	0.399363	0.102645	0.472764	75°00′
0.738932	0.399899	0.102945	0.472590	75°15′
0.739511	0.400438	0.103246	0.472417	75°30′
0.740093	0.400980	0.103545	0.472243	75°45′
0.740679	0.401526	0.103845	0.472068	76°00′
0.741268	0.402075	0.104144	0.471893	76°15′
0.741861	0.402628	0.104442	0.471717	76°30′
0.742457	0.403184	0.104741	0.471541	76°45′
0.743057	0.403744	0.105038	0.471365	77°00′
0.743661	0.404307	0.105336	0.471188	77°15′
0.744268	0.404873	0.105633	0.471010	77°30′
0.744879	0.405443	0.105929	0.470833	77°45′
0.745493	0.406017	0.106226	0.470654	78°00′
0.746112	0.406594	0.106521	0.470476	78°15′
0.746734	0.407174	0.106817	0.470296	78°30′
0.747359	0.407759	0.107112	0.470117	78°45′
0.747989	0.408347	0.107406	0.469937	79°00′
0.748623	0.408938	0.107700	0.469756	79°15′
0.749260	0.409534	0.107994	0.469575	79°30′
0.749901	0.410133	0.108287	0.469394	79°45′
0.750546	0.410736	0.108580	0.469212	80°00′
0.751195	0.411342	0.108873	0.469029	80°15′
0.751849	0.411953	0.109165	0.468847	80°30′
0.752506	0.412567	0.109457	0.468663	80°45′
0.753167	0.413185	0.109748	0.468480	81°00′
0.753832	0.413807	0.110039	0.468296	81°15′
0.754501	0.414433	0.110329	0.468111	81°30′
0.755174	0.415063	0.110619	0.467926	81°45′
0.755851	0.415697	0.110909	0.467741	82°00′
0.756533	0.416334	0.111198	0.467555	82°15′
0.757219	0.416976	0.111487	0.467369	82°30′
0.757908	0.417622	0.111775	0.467182	82°45′
0.758603	0.418272	0.112063	0.466995	83°00′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
83°15′	27°13′39″	0.909292	0.808541	0.416022
83°30′	27°18′21″	0.908765	0.807502	0.416887
83°45′	27°23′03″	0.908237	0.806462	0.417749
84°00′	27°27′45″	0.907708	0.805420	0.418608
84°15′	27°32′27″	0.907177	0.804376	0.419463
84°30′	27°37′09″	0.906645	0.803330	0.420315
84°45′	27°41′51″	0.906111	0.802283	0.421164
85°00′	27°46′33″	0.905576	0.801234	0.422010
85°15′	27°51′14″	0.905040	0.800183	0.422853
85°30′	27°55′56″	0.904502	0.799130	0.423693
85°45′	28°00′37″	0.903963	0.798075	0.424529
86°00′	28°05′18″	0.903423	0.797019	0.425362
86°15′	28°10′00″	0.902881	0.795961	0.426193
86°30′	28°14′41″	0.902338	0.794902	0.427019
86°45′	28°19′21″	0.901794	0.793840	0.427843
87°00′	28°24′02″	0.901248	0.792777	0.428664
87°15′	28°28′43″	0.900701	0.791713	0.429481
87°30′	28°33′23″	0.900153	0.790646	0.430295
87°45′	28°38′04″	0.899603	0.789578	0.431106
88°00′	28°42′44″	0.899052	0.788509	0.431914
88°15′	28°47′24″	0.898500	0.787437	0.432718
88°30′	28°52′04″	0.897947	0.786364	0.433519
88°45′	28°56′44″	0.897392	0.785290	0.434317
89°00′	29°01′24″	0.896836	0.784214	0.435112
89°15′	29°06′03″	0.896278	0.783136	0.435904
89°30′	29°10′43″	0.895719	0.782057	0.436692
89°45′	29°15′22″	0.895159	0.780976	0.437477
90°00′	29°20′01″	0.894598	0.779894	0.438259
90°15′	29°24′40″	0.894035	0.778809	0.439038
90°30′	29°29′19″	0.893471	0.777724	0.439813
90°45′	29°33′58″	0.892905	0.776637	0.440585
91°00′	29°38′37″	0.892339	0.775548	0.441354
91°15′	29°43′16″	0.891771	0.774458	0.442119
91°30′	29°47′54″	0.891202	0.773367	0.442882
91°45′	29°52′32″	0.890631	0.772274	0.443641
92°00′	29°57′11″	0.890059	0.771179	0.444396
92°15′	30°01′49″	0.889486	0.770083	0.445149
92°30′	30°06′27″	0.888912	0.768986	0.445898
92°45′	30°11′04″	0.888336	0.767887	0.446644
93°00′	30°15′42″	0.887759	0.766787	0.447386
93°15′	30°20′20″	0.887181	0.765685	0.448126
93°30′	30°24′57″	0.886602	0.764582	0.448861
93°45′	30°29′34″	0.886021	0.763478	0.449594
94°00′	30°34′11″	0.885439	0.762372	0.450324
94°15′	30°38′48″	0.884856	0.761265	0.451050
94°30′	30°43′25″	0.884271	0.760156	0.451772
94°45′	30°48′02″	0.883685	0.759046	0.452492
95°00′	30°52′38″	0.883098	0.757935	0.453208
95°15′	30°57′15″	0.882510	0.756822	0.453921
95°30′	31°01′51″	0.881920	0.755708	0.454630
95°45′	31°06′27″	0.881330	0.754593	0.455336
96°00′	31°11′03″	0.880737	0.753476	0.456039
96°15′	31°15′39″	0.880144	0.752359	0.456739

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.759301	0.418926	0.112350	0.466807	83°15′
0.760004	0.419584	0.112637	0.466619	83°30′
0.760711	0.420247	0.112924	0.466431	83°45′
0.761422	0.420913	0.113210	0.466242	84°00′
0.762138	0.421584	0.113496	0.466052	84°15′
0.762858	0.422259	0.113781	0.465863	84°30′
0.763583	0.422939	0.114066	0.465673	84°45′
0.764312	0.423622	0.114351	0.465482	85°00′
0.765046	0.424310	0.114635	0.465291	85°15′
0.765784	0.425003	0.114919	0.465100	85°30′
0.766527	0.425700	0.115202	0.464908	85°45′
0.767275	0.426401	0.115485	0.464716	86°00′
0.768027	0.427107	0.115767	0.464523	86°15′
0.768784	0.427817	0.116049	0.464330	86°30′
0.769545	0.428532	0.116330	0.464136	86°45′
0.770312	0.429252	0.116611	0.463942	87°00′
0.771083	0.429976	0.116892	0.463748	87°15′
0.771859	0.430705	0.117172	0.463553	87°30′
0.772640	0.431439	0.117452	0.463358	87°45′
0.773426	0.432177	0.117731	0.463163	88°00′
0.774216	0.432920	0.118010	0.462967	88°15′
0.775012	0.433668	0.118288	0.462770	88°30′
0.775813	0.434421	0.118566	0.462573	88°45′
0.776619	0.435178	0.118844	0.462376	89°00′
0.777429	0.435941	0.119121	0.462179	89°15′
0.778246	0.436709	0.119397	0.461981	89°30′
0.779067	0.437481	0.119673	0.461782	89°45′
0.779893	0.438259	0.119949	0.461584	90°00′
0.780725	0.439042	0.120225	0.461384	90°15′
0.781562	0.439830	0.120499	0.461185	90°30′
0.782404	0.440623	0.120774	0.460985	90°45′
0.783252	0.441421	0.121048	0.460784	91°00′
0.784105	0.442225	0.121321	0.460584	91°15′
0.784964	0.443033	0.121594	0.460382	91°30′
0.785828	0.443848	0.121867	0.460181	91°45′
0.786698	0.444667	0.122139	0.459979	92°00′
0.787573	0.445492	0.122411	0.459777	92°15′
0.788454	0.446323	0.122682	0.459574	92°30′
0.789341	0.447159	0.122953	0.459371	92°45′
0.790233	0.448000	0.123223	0.459167	93°00′
0.791132	0.448847	0.123493	0.458963	93°15′
0.792036	0.449700	0.123762	0.458759	93°30′
0.792946	0.450559	0.124031	0.458554	93°45′
0.793861	0.451423	0.124299	0.458349	94°00′
0.794783	0.452293	0.124568	0.458144	94°15′
0.795711	0.453169	0.124835	0.457938	94°30′
0.796645	0.454051	0.125102	0.457732	94°45′
0.797585	0.454939	0.125369	0.457526	95°00′
0.798531	0.455833	0.125635	0.457319	95°15′
0.799484	0.456733	0.125901	0.457111	95°30′
0.800443	0.457639	0.126166	0.456904	95°45′
0.801408	0.458551	0.126431	0.456696	96°00′
0.802379	0.459469	0.126695	0.456487	96°15′

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

S	i	C/L	Y/L	X/L
96°30′	31°20′15″	0.879549	0.751240	0.457435
96°45′	31°24′51″	0.878954	0.750119	0.458128
97°00′	31°29′26″	0.878357	0.748998	0.458817
97°15′	31°34′01″	0.877758	0.747875	0.459503
97°30′	31°38′37″	0.877159	0.746751	0.460186
97°45′	31°43′12″	0.876558	0.745625	0.460865
98°00′	31°47′47″	0.875956	0.744499	0.461541
98°15′	31°52′21″	0.875353	0.743371	0.462214
98°30′	31°56′56″	0.874748	0.742242	0.462883
98°45′	32°01′30″	0.874142	0.741112	0.463549
99°00′	32°06′05″	0.873536	0.739981	0.464212
99°15′	32°10′39″	0.872927	0.738848	0.464871
99°30′	32°15′13″	0.872318	0.737715	0.465527
99°45′	32°19′47″	0.871707	0.736580	0.466180
100°00′	32°24′20″	0.871096	0.735444	0.466829

TABLE OF FUNCTIONS OF THE STANDARD HIGHWAY SPIRAL

U/L	V/L	p/L	q/L	S
0.803357	0.460394	0.126959	0.456278	96°30′
0.804342	0.461325	0.127222	0.456069	96°45′
0.805333	0.462263	0.127485	0.455860	97°00′
0.806331	0.463206	0.127748	0.455650	97°15′
0.807335	0.464157	0.128010	0.455440	97°30′
0.808346	0.465114	0.128271	0.455229	97°45′
0.809364	0.466077	0.128532	0.455018	98°00′
0.810388	0.467047	0.128793	0.454807	98°15′
0.811420	0.468024	0.129053	0.454595	98°30′
0.812459	0.469008	0.129313	0.454383	98°45′
0.813504	0.469998	0.129572	0.454171	99°00′
0.814557	0.470996	0.129830	0.453958	99°15′
0.815617	0.472000	0.130089	0.453745	99°30′
0.816684	0.473012	0.130346	0.453531	99°45′
0.817758	0.474030	0.130604	0.453317	100°00′

TABLE V

Functions of spirals for varying degrees of curve between 2 minutes and 100 degrees for various values of "a".

Select value of a $(= \frac{D}{L})$ to correspond with value of "a" shown in table. Values of corresponding functions are then directly obtainable from the table.

Tables for the following values of "a" are given:

a = 0.1	a = 1.25	a = 5.5
a = 0.2	a = 1⅓	a = 6.0
a = 0.25	a = 1.5	a = 6.5
a = 0.3	a = 1.75	a = 7.0
a = 0.4	a = 2.0	a = 8.0
a = 0.5	a = 2.5	a = 9.0
a = 0.6	a = 3.0	a = 10.0
a = 0.7	a = 3.5	a = 12.5
a = 0.8	a = 4.0	a = 15.0
a = 0.9	a = 4.5	a = 20.0
a = 1.0	a = 5.0	a = 25.0

THE STANDARD HIGHWAY SPIRAL

$a = 0.1$

L	D	S	q	p	Y	X	C	U	V
10	0°00.6′	0°00.03′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°01.2′	0°00.12′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°01.8′	0°00.27′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°02.4′	0°00.48′	20.00	0.00	40.00	0.00	40.00	26.67	13.33
50	0°03.0′	0°00.75′	25.00	0.00	50.00	0.00	50.00	33.33	16.67
60	0°03.6′	0°01.08′	30.00	0.00	60.00	0.01	60.00	40.00	20.00
70	0°04.2′	0°01.47′	35.00	0.00	70.00	0.01	70.00	46.67	23.33
80	0°04.8′	0°01.92′	40.00	0.00	80.00	0.01	80.00	53.33	26.67
90	0°05.4′	0°02.43′	45.00	0.00	90.00	0.02	90.00	60.00	30.00
100	0°06.0′	0°03.00′	50.00	0.01	100.00	0.03	100.00	66.67	33.33
110	0°06.6′	0°03.63′	55.00	0.01	110.00	0.04	110.00	73.33	36.67
120	0°07.2′	0°04.32′	60.00	0.01	120.00	0.05	120.00	80.00	40.00
130	0°07.8′	0°05.07′	65.00	0.02	130.00	0.06	130.00	86.67	43.33
140	0°08.4′	0°05.88′	70.00	0.02	140.00	0.08	140.00	93.33	46.67
150	0°09.0′	0°06.75′	75.00	0.02	150.00	0.10	150.00	100.00	50.00
160	0°09.6′	0°07.68′	80.00	0.03	160.00	0.12	160.00	106.67	53.33
170	0°10.2′	0°08.67′	85.00	0.04	170.00	0.14	170.00	113.33	56.67
180	0°10.8′	0°09.72′	90.00	0.04	180.00	0.17	180.00	120.00	60.00
190	0°11.4′	0°10.83′	95.00	0.05	190.00	0.20	190.00	126.67	63.33
200	0°12.0′	0°12.00′	100.00	0.06	200.00	0.23	200.00	133.33	66.67
210	0°12.6′	0°13.23′	105.00	0.07	210.00	0.27	210.00	140.00	70.00
220	0°13.2′	0°14.52′	110.00	0.08	220.00	0.31	220.00	146.67	73.33
230	0°13.8′	0°15.87′	115.00	0.09	230.00	0.35	230.00	153.33	76.67
240	0°14.4′	0°17.28′	120.00	0.10	240.00	0.40	240.00	160.00	80.00
250	0°15.0′	0°18.75′	125.00	0.11	250.00	0.45	250.00	166.67	83.33
260	0°15.6′	0°20.28′	130.00	0.13	260.00	0.51	260.00	173.33	86.67
270	0°16.2′	0°21.87′	135.00	0.14	270.00	0.57	270.00	180.00	90.00
280	0°16.8′	0°23.52′	140.00	0.16	280.00	0.64	280.00	186.67	93.33
290	0°17.4′	0°25.23′	145.00	0.18	290.00	0.71	290.00	193.33	96.67
300	0°18.0′	0°27.00′	150.00	0.20	300.00	0.79	300.00	200.00	100.00
210	0°18.6′	0°28.83′	155.00	0.22	310.00	0.87	310.00	206.67	103.33
310	0°18.6′	0°28.83′	155.00	0.22	310.00	0.87	310.00	206.67	103.33
320	0°19.2′	0°30.72′	160.00	0.24	320.00	0.95	320.00	213.33	106.67
330	0°19.8′	0°32.67′	165.00	0.26	330.00	1.05	330.00	220.00	110.00
340	0°20.4′	0°34.68′	170.00	0.29	340.00	1.14	340.00	226.67	113.33
350	0°21.0′	0°36.75′	175.00	0.31	350.00	1.25	350.00	233.33	116.67
360	0°21.6′	0°38.88′	180.00	0.34	360.00	1.36	360.00	240.00	120.00
370	0°22.2′	0°41.07′	185.00	0.37	369.99	1.47	370.00	246.67	123.34
380	0°22.8′	0°43.32′	190.00	0.40	379.99	1.60	380.00	253.34	126.67
390	0°23.4′	0°45.63′	195.00	0.43	389.99	1.73	390.00	260.00	130.00
400	0°24.0′	0°48.00′	200.00	0.47	399.99	1.86	400.00	266.67	133.34
410	0°24.6′	0°50.43′	205.00	0.50	409.99	2.00	410.00	273.34	136.67
420	0°25.2′	0°52.92′	210.00	0.54	419.99	2.16	420.00	280.00	140.00
430	0°25.8′	0°55.47′	215.00	0.58	429.99	2.31	430.00	286.67	143.34
440	0°26.4′	0°58.08′	220.00	0.62	439.99	2.48	439.99	293.34	146.67
450	0°27.0′	1°00.75′	225.00	0.66	449.99	2.65	449.99	300.00	150.00
460	0°27.6′	1°03.48′	230.00	0.71	459.98	2.83	459.99	306.67	153.34
470	0°28.2′	1°06.27′	235.00	0.75	469.98	3.02	469.99	313.34	156.67
480	0°28.8′	1°09.12′	240.00	0.80	479.98	3.22	479.99	320.01	160.01
490	0°29.4′	1°12.03′	245.00	0.86	489.98	3.42	489.99	326.67	163.34
500	0°30.0′	1°15.00′	250.00	0.91	499.98	3.64	499.99	333.34	166.67

THE STANDARD HIGHWAY SPIRAL

a = 0.1—Continued

L	D	S	q	p	Y	X	C	U	V
510	0°30.6′	1°18.03′	255.00	0.96	509.97	3.86	509.99	340.01	170.01
520	0°31.2′	1°21.12′	260.00	1.02	519.97	4.09	519.99	346.68	173.34
530	0°31.8′	1°24.27′	264.99	1.08	529.97	4.33	529.99	353.34	176.68
540	0°32.4′	1°27.43′	269.99	1.15	539.97	4.58	539.98	360.01	180.01
550	0°33.0′	1°30.75′	274.99	1.21	549.96	4.84	549.98	366.68	183.35
560	0°33.6′	1°34.08′	279.99	1.28	559.96	5.11	559.98	373.35	186.68
570	0°34.2′	1°37.47′	284.99	1.35	569.95	5.39	569.98	380.02	190.01
580	0°34.8′	1°40.92′	289.99	1.42	579.95	5.68	579.98	386.68	193.35
590	0°35.4′	1°44.43′	294.99	1.49	589.95	5.97	589.98	393.35	196.68
600	0°36.0′	1°48.00′	299.99	1.57	599.94	6.28	599.97	400.02	200.02
610	0°36.6′	1°51.63′	304.99	1.65	609.94	6.60	609.97	406.69	203.35
620	0°37.2′	1°55.32′	309.99	1.73	619.93	6.93	619.97	413.36	206.69
630	0°37.8′	1°59.07′	314.99	1.82	629.92	7.27	629.97	420.03	210.02
640	0°38.4′	2°02.88′	319.99	1.91	639.92	7.62	639.96	426.70	213.36
650	0°39.0′	2°06.75′	324.99	2.00	649.91	7.99	649.96	433.36	216.69
660	0°39.6′	2°10.68′	329.98	2.09	659.90	8.36	659.96	440.03	220.03
670	0°40.2′	2°14.67′	334.98	2.19	669.90	8.75	669.95	446.70	223.37
680	0°40.8′	2°18.72′	339.98	2.29	679.89	9.15	679.95	453.37	226.70
690	0°41.4′	2°22.83′	344.98	2.39	689.88	9.55	689.95	460.04	230.04
700	0°42.0′	2°27.00′	349.98	2.49	699.87	9.98	699.94	466.71	233.37
710	0°42.6′	2°31.23′	354.98	2.60	709.86	10.41	709.94	473.38	236.71
720	0°43.2′	2°35.52′	359.98	2.71	719.85	10.86	719.93	480.05	240.05
730	0°43.8′	2°39.87′	364.97	2.83	729.84	11.31	729.93	486.72	243.38
740	0°44.4′	2°44.28′	369.97	2.95	739.83	11.79	739.92	493.39	246.72
750	0°45.0′	2°48.75′	374.97	3.07	749.82	12.27	749.92	500.06	250.06
760	0°45.6′	2°53.28′	379.97	3.19	759.81	12.77	759.91	506.73	253.39
770	0°46.2′	2°57.87′	384.97	3.32	769.79	13.28	769.91	513.41	256.73
780	0°46.8′	3°02.52′	389.96	3.45	779.78	13.80	779.90	520.08	260.07
790	0°47.4′	3°07.23′	394.96	3.59	789.77	14.34	789.90	526.75	263.41
800	0°48.0′	3°12.00′	399.96	3.72	799.75	14.89	799.89	533.42	266.75
810	0°48.6′	3°16.85′	404.96	3.86	809.73	15.46	809.88	540.09	270.08
820	0°49.2′	3°21.72′	409.95	4.01	819.72	16.03	819.87	546.77	273.42
830	0°49.8′	3°26.67′	414.95	4.16	829.70	16.63	829.87	553.44	276.76
840	0°50.4′	3°31.68′	419.95	4.31	839.68	17.24	839.86	560.11	280.10
850	0°51.0′	3°36.75′	424.94	4.47	849.66	17.86	849.85	566.78	283.44
860	0°51.6′	3°41.88′	429.94	4.62	859.64	18.50	859.84	573.46	286.78
870	0°52.2′	3°47.07′	434.94	4.79	869.62	19.15	869.83	580.13	290.12
880	0°52.8′	3°52.32′	439.93	4.95	879.60	19.82	879.82	586.81	293.46
890	0°53.4′	3°57.63′	444.93	5.13	889.57	20.50	889.81	593.48	296.80
900	0°54.0′	4°03.00′	449.93	5.30	899.55	21.20	899.80	600.16	300.14
910	0°54.6′	4°08.43′	454.92	5.48	909.52	21.91	909.79	606.83	303.48
920	0°55.2′	4°13.92′	459.92	5.66	919.50	22.64	919.78	613.51	306.83
930	0°55.8′	4°19.47′	464.91	5.85	929.47	23.39	929.76	620.19	310.17
940	0°56.4′	4°25.08′	469.91	6.04	939.44	24.15	939.75	626.86	313.51
950	0°57.0′	4°30.75′	474.90	6.23	949.41	24.93	949.74	633.54	316.85
960	0°57.6′	4°36.48′	479.90	6.43	959.38	25.72	959.72	640.22	320.20
970	0°58.2′	4°42.27′	484.89	6.64	969.35	26.54	969.71	646.90	323.54
980	0°58.8′	4°48.12′	489.89	6.84	979.31	27.36	979.69	653.57	326.89
990	0°59.4′	4°54.03′	494.88	7.05	989.28	28.21	989.68	660.25	330.23
1000	1°00.0′	5°00.00′	499.87	7.27	999.24	29.07	999.66	666.93	333.58

THE STANDARD HIGHWAY SPIRAL

a = 0.2

L	D	S	q	p	Y	X	C	U	V
10	0°01.2′	0°00.06′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°02.4′	0°00.24′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°03.6′	0°00.54′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°04.8′	0°00.96′	20.00	0.00	40.00	0.00	40.00	26.67	13.33
50	0°06.0′	0°01.50′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
60	0°07.2′	0°02.16′	30.00	0.00	60.00	0.01	60.00	40.00	20.00
70	0°08.4′	0°02.94′	35.00	0.00	70.00	0.02	70.00	46.67	23.33
80	0°09.6′	0°03.84′	40.00	0.01	80.00	0.03	80.00	53.33	26.67
90	0°10.8′	0°04.86′	45.00	0.01	90.00	0.04	90.00	60.00	30.00
100	0°12.0′	0°06.00′	50.00	0.01	100.00	0.06	100.00	66.67	33.33
110	0°13.2′	0°07.26′	55.00	0.02	110.00	0.08	110.00	73.33	36.67
120	0°14.4′	0°08.64′	60.00	0.03	120.00	0.10	120.00	80.00	40.00
130	0°15.6′	0°10.14′	65.00	0.03	130.00	0.13	130.00	86.67	43.33
140	0°16.8′	0°11.76′	70.00	0.04	140.00	0.16	140.00	93.33	46.67
150	0°18.0′	0°13.50′	75.00	0.05	150.00	0.20	150.00	100.00	50.00
160	0°19.2′	0°15.36′	80.00	0.06	160.00	0.24	160.00	106.67	53.33
170	0°20.4′	0°17.34′	85.00	0.07	170.00	0.29	170.00	113.33	56.67
180	0°21.6′	0°19.44′	90.00	0.08	180.00	0.34	180.00	120.00	60.00
190	0°22.8′	0°21.66′	95.00	0.10	190.00	0.40	190.00	126.67	63.33
200	0°24.0′	0°24.00′	100.00	0.12	200.00	0.47	200.00	133.33	66.67
210	0°25.2′	0°26.46′	105.00	0.13	210.00	0.54	210.00	140.00	70.00
220	0°26.4′	0°29.04′	110.00	0.15	220.00	0.62	220.00	146.67	73.33
230	0°27.6′	0°31.74′	115.00	0.18	230.00	0.71	230.00	153.33	76.67
240	0°28.8′	0°34.56′	120.00	0.20	240.00	0.80	240.00	160.00	80.00
250	0°30.0′	0°37.50′	125.00	0.23	250.00	0.91	250.00	166.67	83.33
260	0°31.2′	0°40.56′	130.00	0.26	260.00	1.02	260.00	173.33	86.67
270	0°32.4′	0°43.74′	135.00	0.29	270.00	1.15	270.00	180.00	90.00
280	0°33.6′	0°47.04′	140.00	0.32	279.99	1.28	280.00	186.67	93.34
290	0°34.8′	0°50.46′	145.00	0.35	289.99	1.42	290.00	193.34	96.67
300	0°36.0′	0°54.00′	150.00	0.39	299.99	1.57	300.00	200.00	100.00
310	0°37.2′	0°57.66′	155.00	0.43	309.99	1.73	310.00	206.67	103.34
320	0°38.4′	1°01.44′	160.00	0.48	319.99	1.91	320.00	213.34	106.67
330	0°39.6′	1°05.34′	165.00	0.52	329.99	2.09	329.99	220.00	110.00
340	0°40.8′	1°09.36′	170.00	0.57	339.99	2.29	339.99	226.67	113.34
350	0°42.0′	1°13.50′	175.00	0.62	349.98	2.49	349.99	233.34	116.67
360	0°43.2′	1°17.76′	180.00	0.68	359.98	2.71	359.99	240.01	120.01
370	0°44.4′	1°22.14′	185.00	0.74	369.98	2.95	369.99	246.67	123.34
380	0°45.6′	1°26.64′	190.00	0.80	379.98	3.19	379.99	253.34	126.67
390	0°46.8′	1°31.26′	195.00	0.86	389.97	3.45	389.99	260.01	130.01
400	0°48.0′	1°36.00′	199.99	0.93	399.97	3.72	399.99	266.68	133.34
410	0°49.2′	1°40.86′	204.99	1.00	409.96	4.01	409.98	273.35	136.68
420	0°50.4′	1°45.84′	209.99	1.08	419.96	4.31	419.98	280.01	140.01
430	0°51.6′	1°50.94′	214.99	1.16	429.96	4.63	429.98	286.68	143.35
440	0°52.8′	1°56.16′	219.99	1.24	439.95	4.96	439.98	293.35	146.68
450	0°54.0′	2°01.50′	224.99	1.33	449.94	5.30	449.98	300.02	150.02
460	0°55.2′	2°06.96′	229.99	1.42	459.94	5.66	459.97	306.69	153.35
470	0°56.4′	2°12.54′	234.99	1.51	469.93	6.04	469.97	313.36	156.69
480	0°57.6′	2°18.24′	239.99	1.61	479.92	6.43	479.97	320.03	160.02
490	0°58.8′	2°24.06′	244.99	1.71	489.91	6.84	489.96	326.70	163.36
500	1°00.0′	2°30.00′	249.98	1.82	499.90	7.27	499.96	333.37	166.70

THE STANDARD HIGHWAY SPIRAL

a = 0.2—Continued

L	D	S	q	p	Y	X	C	U	V
510	1°01.2′	2°36.06′	254.98	1.93	509.89	7.72	509.95	340.04	170.03
520	1°02.4′	2°42.24′	259.98	2.04	519.88	8.18	519.95	346.71	173.37
530	1°03.6′	2°48.54′	264.98	2.17	529.87	8.66	529.94	353.38	176.71
540	1°04.8′	2°54.96′	269.98	2.29	539.86	9.16	539.94	360.05	180.04
550	1°06.0′	3°01.50′	274.97	2.42	549.85	9.68	549.93	366.72	183.38
560	1°07.2′	3°08.16′	279.97	2.55	559.83	10.21	559.93	373.39	186.72
570	1°08.4′	3°14.94′	284.97	2.69	569.82	10.77	569.92	380.06	190.06
580	1°09.6′	3°21.84′	289.97	2.84	579.80	11.35	579.91	386.74	193.40
590	1°10.8′	3°28.86′	294.96	2.99	589.78	11.95	589.90	393.41	196.74
600	1°12.0′	3°36.00′	299.96	3.14	599.76	12.56	599.89	400.08	200.08
610	1°13.2′	3°43.26′	304.96	3.30	609.74	13.20	609.89	406.76	203.42
620	1°14.4′	3°50.64′	309.95	3.47	619.72	13.86	619.88	413.43	206.76
630	1°15.6′	3°58.14′	314.95	3.64	629.70	14.54	629.87	420.11	210.10
640	1°16.8′	4°05.76′	319.95	3.81	639.67	15.25	639.85	426.78	213.44
650	1°18.0′	4°13.50′	324.94	3.99	649.65	15.97	649.84	433.46	216.78
660	1°19.2′	4°21.36′	329.94	4.18	659.62	16.72	659.83	440.13	220.12
670	1°20.4′	4°29.34′	334.93	4.37	669.59	17.49	669.82	446.81	223.46
680	1°21.6′	4°37.44′	339.93	4.57	679.56	18.28	679.80	453.49	226.81
690	1°22.8′	4°45.66′	344.92	4.78	689.52	19.10	689.79	460.17	230.15
700	1°24.0′	4°54.00′	349.91	4.99	699.49	19.94	699.77	466.85	233.50
710	1°25.2′	5°02.46′	354.91	5.20	709.45	20.81	709.76	473.53	236.84
720	1°26.4′	5°11.04′	359.90	5.43	719.41	21.70	719.74	480.21	240.19
730	1°27.6′	5°19.74′	364.89	5.66	729.37	22.62	729.72	486.89	243.53
740	1°28.8′	5°28.56′	369.89	5.89	739.32	23.56	739.70	493.57	246.88
750	1°30.0′	5°37.50′	374.88	6.13	749.28	24.53	749.68	500.25	250.23
760	1°31.2′	5°46.56′	379.87	6.38	759.23	25.52	759.66	506.94	253.58
770	1°32.4′	5°55.74′	384.86	6.64	769.18	26.54	769.63	513.62	256.93
780	1°33.6′	6°05.04′	389.85	6.90	779.12	27.59	779.61	520.31	260.28
790	1°34.8′	6°14.46′	394.84	7.17	789.06	28.66	789.58	526.99	263.63
800	1°36.0′	6°24.00′	399.83	7.44	799.00	29.76	799.56	533.68	266.98
810	1°37.2′	6°33.66′	404.82	7.73	808.94	30.89	809.53	540.37	270.34
820	1°38.4′	6°43.44′	409.81	8.02	818.87	32.05	819.50	547.06	273.69
830	1°39.6′	6°53.34′	414.80	8.31	828.80	33.23	829.47	553.75	277.05
840	1°40.8′	7°03.36′	419.79	8.62	838.73	34.44	839.43	560.45	280.41
850	1°42.0′	7°13.50′	424.77	8.93	848.65	35.69	849.40	567.14	283.76
860	1°43.2′	7°23.76′	429.76	9.25	858.57	36.96	859.36	573.83	287.12
870	1°44.4′	7°34.14′	434.75	9.57	868.48	38.26	869.33	580.53	290.48
880	1°45.6′	7°44.64′	439.73	9.91	878.39	39.59	879.29	587.23	293.84
890	1°46.8′	7°55.26′	444.72	10.25	888.30	40.96	889.24	593.93	297.21
900	1°48.0′	8°06.00′	449.70	10.60	898.20	42.35	899.20	600.63	300.57
910	1°49.2′	8°16.86′	454.68	10.95	908.10	43.78	909.16	607.33	303.94
920	1°50.4′	8°27.84′	459.67	11.32	917.99	45.23	919.11	614.04	307.31
930	1°51.6′	8°38.94′	464.65	11.69	927.88	46.72	929.06	620.74	310.67
940	1°52.8′	8°50.16′	469.63	12.07	937.77	48.24	939.01	627.45	314.04
950	1°54.0′	9°01.50′	474.61	12.46	947.65	49.79	948.95	634.16	317.42
960	1°55.2′	9°12.96′	479.59	12.86	957.52	51.38	958.90	640.87	320.79
970	1°56.4′	9°24.54′	484.56	13.26	967.39	52.99	968.84	647.58	324.17
980	1°57.6′	9°36.24′	489.54	13.68	977.25	54.65	978.78	654.30	327.54
990	1°58.8′	9°48.06′	494.52	14.10	987.11	56.33	988.71	661.01	330.92
1000	2°00.0′	10°00.00′	499.49	14.53	996.96	58.05	998.65	667.73	334.30

THE STANDARD HIGHWAY SPIRAL

a = 0.25

L	D	S	q	p	Y	X	C	U	V
10	0°01.5′	0°00.08′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°03.0′	0°00.30′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°04.5′	0°00.68′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°06.0′	0°01.20′	20.00	0.00	40.00	0.00	40.00	26.67	13.33
50	0°07.5′	0°01.88′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
60	0°09.0′	0°02.70′	30.00	0.00	60.00	0.02	60.00	40.00	20.00
70	0°10.5′	0°03.68′	35.00	0.01	70.00	0.02	70.00	46.67	23.33
80	0°12.0′	0°04.80′	40.00	0.01	80.00	0.04	80.00	53.33	26.67
90	0°13.5′	0°06.08′	45.00	0.01	90.00	0.05	90.00	60.00	30.00
100	0°15.0′	0°07.50′	50.00	0.02	100.00	0.07	100.00	66.67	33.33
110	0°16.5′	0°09.08′	55.00	0.02	110.00	0.10	110.00	73.33	36.67
120	0°18.0′	0°10.80′	60.00	0.03	120.00	0.13	120.00	80.00	40.00
130	0°19.5′	0°12.68′	65.00	0.04	130.00	0.16	130.00	86.67	43.33
140	0°21.0′	0°14.70′	70.00	0.05	140.00	0.20	140.00	93.33	46.67
150	0°22.5′	0°16.88′	75.00	0.06	150.00	0.25	150.00	100.00	50.00
160	0°24.0′	0°19.20′	80.00	0.07	160.00	0.30	160.00	106.67	53.33
170	0°25.5′	0°21.68′	85.00	0.09	170.00	0.36	170.00	113.33	56.67
180	0°27.0′	0°24.30′	90.00	0.11	180.00	0.42	180.00	120.00	60.00
190	0°28.5′	0°27.08′	95.00	0.12	190.00	0.50	190.00	126.67	63.33
200	0°30.0′	0°30.00′	100.00	0.15	200.00	0.58	200.00	133.33	66.67
210	0°31.5′	0°33.08′	105.00	0.17	210.00	0.67	210.00	140.00	70.00
220	0°33.0′	0°36.30′	110.00	0.19	220.00	0.77	220.00	146.67	73.33
230	0°34.5′	0°39.68′	115.00	0.22	230.00	0.88	230.00	153.33	76.67
240	0°36.0′	0°43.20′	120.00	0.25	240.00	1.01	240.00	160.00	80.00
250	0°37.5′	0°46.88′	125.00	0.28	250.00	1.14	250.00	166.67	83.33
260	0°39.0′	0°50.70′	130.00	0.32	259.99	1.28	260.00	173.34	86.67
270	0°40.5′	0°54.68′	135.00	0.36	269.99	1.43	270.00	180.00	90.00
280	0°42.0′	0°58.80′	140.00	0.40	279.99	1.60	280.00	186.67	93.34
290	0°43.5′	1°03.08′	145.00	0.44	289.99	1.77	290.00	193.34	96.67
300	0°45.0′	1°07.50′	150.00	0.49	299.99	1.96	299.99	200.00	100.00
310	0°46.5′	1°12.08′	155.00	0.54	309.99	2.17	309.99	206.67	103.34
320	0°48.0′	1°16.80′	160.00	0.60	319.98	2.38	319.99	213.34	106.67
330	0°49.5′	1°21.68′	165.00	0.65	329.98	2.61	329.99	220.01	110.01
340	0°51.0′	1°26.70′	170.00	0.71	339.98	2.86	339.99	226.67	113.34
350	0°52.5′	1°31.88′	175.00	0.78	349.97	3.12	349.99	233.34	116.67
360	0°54.0′	1°37.20′	180.00	0.85	359.97	3.39	359.99	240.01	120.01
370	0°55.5′	1°42.68′	184.99	0.92	369.97	3.68	369.99	246.68	123.34
380	0°57.0′	1°48.30′	189.99	1.00	379.96	3.99	379.98	253.35	126.68
390	0°58.5′	1°54.08′	194.99	1.08	389.96	4.31	389.98	260.01	130.01
400	1°00.0′	2°00.00′	199.99	1.16	399.95	4.65	399.98	266.68	133.35
410	1°01.5′	2°06.08′	204.99	1.25	409.94	5.01	409.98	273.35	136.68
420	1°03.0′	2°12.30′	209.99	1.35	419.94	5.39	419.97	280.02	140.02
430	1°04.5′	2°18.68′	214.99	1.45	429.93	5.78	429.97	286.69	143.36
440	1°06.0′	2°25.20′	219.99	1.55	439.92	6.19	439.97	293.36	146.69
450	1°07.5′	2°31.88′	224.99	1.66	449.91	6.63	449.96	300.03	150.03
460	1°09.0′	2°38.70′	229.98	1.77	459.90	7.08	459.96	306.70	153.36
470	1°10.5′	2°45.68′	234.98	1.89	469.89	7.55	469.95	313.37	156.70
480	1°12.0′	2°52.80′	239.98	2.01	479.88	8.04	479.95	320.04	160.04
490	1°13.5′	3°00.08′	244.98	2.14	489.87	8.55	489.94	326.71	163.38
500	1°15.0′	3°07.50′	249.98	2.27	499.85	9.09	499.93	333.39	166.71

THE STANDARD HIGHWAY SPIRAL

a = 0.25—Continued

L	D	S	q	p	Y	X	C	U	V
510	1°16.5′	3°15.08′	254.97	2.41	509.84	9.64	509.93	340.06	170.05
520	1°18.0′	3°22.80′	259.97	2.56	519.82	10.22	519.92	346.73	173.39
530	1°19.5′	3°30.68′	264.97	2.71	529.80	10.82	529.91	353.40	176.73
540	1°21.0′	3°38.70′	269.96	2.86	539.78	11.45	539.90	360.08	180.07
550	1°22.5′	3°46.88′	274.96	3.02	549.76	12.10	549.89	366.75	183.41
560	1°24.0′	3°55.20′	279.96	3.19	559.74	12.77	559.88	373.42	186.75
570	1°25.5′	4°03.68′	284.95	3.37	569.71	13.46	569.87	380.10	190.09
580	1°27.0′	4°12.30′	289.95	3.55	579.69	14.18	579.86	386.78	193.43
590	1°28.5′	4°21.08′	294.94	3.73	589.66	14.93	589.85	393.45	196.77
600	1°30.0′	4°30.00′	299.94	3.93	599.63	15.70	599.84	400.13	200.12
610	1°31.5′	4°39.08′	304.93	4.13	609.60	16.50	609.82	406.81	203.46
620	1°33.0′	4°48.30′	309.93	4.33	619.56	17.32	619.81	413.49	206.81
630	1°34.5′	4°57.68′	314.92	4.54	629.53	18.17	629.79	420.17	210.15
640	1°36.0′	5°07.20′	319.91	4.76	639.49	19.05	639.77	426.85	213.50
650	1°37.5′	5°16.88′	324.91	4.99	649.45	19.96	649.75	433.53	216.84
660	1°39.0′	5°26.70′	329.90	5.23	659.40	20.89	659.74	440.21	220.19
670	1°40.5′	5°36.68′	334.89	5.47	669.36	21.86	669.71	446.89	223.54
680	1°42.0′	5°46.80′	339.88	5.71	679.31	22.85	679.69	453.58	226.89
690	1°43.5′	5°57.08′	344.88	5.97	689.26	23.87	689.67	460.26	230.24
700	1°45.0′	6°07.50′	349.87	6.23	699.20	24.92	699.64	466.95	233.59
710	1°46.5′	6°18.08′	354.86	6.50	709.14	26.01	709.62	473.63	236.94
720	1°48.0′	6°28.80′	359.85	6.78	719.08	27.12	719.59	480.32	240.29
730	1°49.5′	6°39.68′	364.84	7.07	729.01	28.26	729.56	487.01	243.65
740	1°51.0′	6°50.70′	369.82	7.36	738.94	29.44	739.53	493.70	247.00
750	1°52.5′	7°01.88′	374.81	7.67	748.87	30.65	749.50	500.39	250.36
760	1°54.0′	7°13.20′	379.80	7.98	758.79	31.89	759.46	507.09	253.72
770	1°55.5′	7°24.68′	384.79	8.30	768.71	33.16	769.43	513.78	257.08
780	1°57.0′	7°36.30′	389.77	8.62	778.63	34.47	779.39	520.48	260.44
790	1°58.5′	7°48.08′	394.76	8.96	788.54	35.81	789.35	527.18	263.80
800	2°00.0′	8°00.00′	399.74	9.30	798.44	37.18	799.31	533.88	267.16
810	2°01.5′	8°12.08′	404.72	9.65	808.34	38.59	809.26	540.58	270.53
820	2°03.0′	8°24.30′	409.71	10.02	818.24	40.04	819.22	547.28	273.89
830	2°04.5′	8°36.68′	414.69	10.39	828.13	41.51	829.17	553.99	277.26
840	2°06.0′	8°49.20′	419.67	10.77	838.01	43.03	839.12	560.70	280.63
850	2°07.5′	9°01.88′	424.65	11.16	847.89	44.58	849.06	567.41	284.01
860	2°09.0′	9°14.70′	429.63	11.55	857.76	46.17	859.01	574.12	287.38
870	2°10.5′	9°27.68′	434.60	11.96	867.63	47.79	868.95	580.83	290.76
880	2°12.0′	9°40.80′	439.58	12.38	877.49	49.46	878.88	587.55	294.13
890	2°13.5′	9°54.08′	444.56	12.80	887.35	51.16	888.82	594.26	297.51
900	2°15.0′	10°07.50′	449.53	13.24	897.19	52.90	898.75	600.98	300.90
910	2°16.5′	10°21.08′	454.51	13.68	907.03	54.67	908.68	607.71	304.28
920	2°18.0′	10°34.80′	459.48	14.14	916.87	56.49	918.61	614.43	307.67
930	2°19.5′	10°48.68′	464.45	14.61	926.69	58.35	928.53	621.16	311.06
940	2°21.0′	11°02.70′	469.42	15.08	936.51	60.24	938.45	627.89	314.45
950	2°22.5′	11°16.88′	474.39	15.57	946.32	62.18	948.36	634.62	317.84
960	2°24.0′	11°31.20′	479.35	16.06	956.13	64.15	958.28	641.36	321.24
970	2°25.5′	11°45.68′	484.32	16.57	965.92	66.17	968.18	648.10	324.64
980	2°27.0′	12°00.30′	489.28	17.08	975.71	68.23	978.09	654.84	328.04
990	2°28.5′	12°15.08′	494.25	17.61	985.48	70.33	987.99	661.59	331.44
1000	2°30.0′	12°30.00′	499.21	18.15	995.25	72.48	997.89	668.34	334.85

THE STANDARD HIGHWAY SPIRAL

a = 0.3

L	D	S	q	p	Y	X	C	U	V
10	0°01.8′	0°00.09′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°03.6′	0°00.36′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°05.4′	0°00.81′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°07.2′	0°01.44′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°09.0′	0°02.25′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
60	0°10.8′	0°03.24′	30.00	0.00	60.00	0.02	60.00	40.00	20.00
70	0°12.6′	0°04.41′	35.00	0.01	70.00	0.03	70.00	46.67	23.33
80	0°14.4′	0°05.76′	40.00	0.01	80.00	0.04	80.00	53.33	26.67
90	0°16.2′	0°07.29′	45.00	0.02	90.00	0.06	90.00	60.00	30.00
100	0°18.0′	0°09.00′	50.00	0.02	100.00	0.09	100.00	66.67	33.33
110	0°19.8′	0°10.89′	55.00	0.03	110.00	0.12	110.00	73.33	36.67
120	0°21.6′	0°12.96′	60.00	0.04	120.00	0.15	120.00	80.00	40.00
130	0°23.4′	0°15.21′	65.00	0.05	130.00	0.19	130.00	86.67	43.33
140	0°25.2′	0°17.64′	70.00	0.06	140.00	0.24	140.00	93.33	46.67
150	0°27.0′	0°20.25′	75.00	0.07	150.00	0.29	150.00	100.00	50.00
160	0°28.8′	0°23.04′	80.00	0.09	160.00	0.36	160.00	106.67	53.33
170	0°30.6′	0°26.01′	85.00	0.11	170.00	0.43	170.00	113.33	56.67
180	0°32.4′	0°29.16′	90.00	0.13	180.00	0.51	180.00	120.00	60.00
190	0°34.2′	0°32.49′	95.00	0.15	190.00	0.60	190.00	126.67	63.33
200	0°36.0′	0°36.00′	100.00	0.17	200.00	0.70	200.00	133.33	66.67
210	0°37.8′	0°39.69′	105.00	0.20	210.00	0.81	210.00	140.00	70.00
220	0°39.6′	0°43.56′	110.00	0.23	220.00	0.93	220.00	146.67	73.33
230	0°41.4′	0°47.61′	115.00	0.27	230.00	1.06	230.00	153.33	76.67
240	0°43.2′	0°51.84′	120.00	0.30	239.99	1.21	240.00	160.00	80.00
250	0°45.0′	0°56.25′	125.00	0.34	249.99	1.36	250.00	166.67	83.34
260	0°46.8′	1°00.84′	130.00	0.38	259.99	1.53	260.00	173.34	86.67
270	0°48.6′	1°05.61′	135.00	0.43	269.99	1.72	270.00	180.00	90.00
280	0°50.4′	1°10.56′	140.00	0.48	279.99	1.92	279.99	186.67	93.34
290	0°52.2′	1°15.69′	145.00	0.53	289.99	2.13	289.99	193.34	96.67
300	0°54.0′	1°21.00′	150.00	0.59	299.98	2.36	299.99	200.01	100.01
310	0°55.8′	1°26.49′	155.00	0.65	309.98	2.60	309.99	206.67	103.34
320	0°57.6′	1°32.16′	160.00	0.71	319.98	2.86	319.99	213.34	106.67
330	0°59.4′	1°38.01′	165.00	0.78	329.97	3.14	329.99	220.01	110.01
340	1°01.2′	1°44.04′	169.99	0.86	339.97	3.43	339.99	226.68	113.34
350	1°03.0′	1°50.25′	174.99	0.94	349.96	3.74	349.98	233.35	116.68
360	1°04.8′	1°56.64′	179.99	1.02	359.96	4.07	359.98	240.01	120.01
370	1°06.6′	2°03.21′	184.99	1.11	369.95	4.42	369.98	246.68	123.35
380	1°08.4′	2°09.96′	189.99	1.20	379.95	4.79	379.98	253.35	126.68
390	1°10.2′	2°16.89′	194.99	1.29	389.94	5.18	389.97	260.02	130.02
400	1°12.0′	2°24.00′	199.99	1.40	399.93	5.58	399.97	266.69	133.36
410	1°13.8′	2°31.29′	204.99	1.50	409.92	6.01	409.96	273.36	136.69
420	1°15.6′	2°38.76′	209.99	1.62	419.91	6.46	419.96	280.03	140.03
430	1°17.4′	2°46.41′	214.98	1.73	429.90	6.94	429.96	286.70	143.37
440	1°19.2′	2°54.24′	219.98	1.86	439.89	7.43	439.95	293.37	146.70
450	1°21.0′	3°02.25′	224.98	1.99	449.87	7.95	449.94	300.04	150.04
460	1°22.8′	3°10.44′	229.98	2.12	459.86	8.49	459.94	306.72	153.38
470	1°24.6′	3°18.81′	234.97	2.26	469.84	9.06	469.93	313.39	156.72
480	1°26.4′	3°27.36′	239.97	2.41	479.83	9.65	479.92	320.06	160.06
490	1°28.2′	3°36.09′	244.97	2.57	489.81	10.26	489.91	326.73	163.39
500	1°30.0′	3°45.00′	249.96	2.73	499.79	10.90	499.90	333.41	166.73

THE STANDARD HIGHWAY SPIRAL

a = 0.3—Continued

L	D	S	q	p	Y	X	C	U	V
510	1°31.8′	3°54.09′	254.96	2.89	509.76	11.57	509.89	340.08	170.08
520	1°33.6′	4°03.36′	259.96	3.07	519.74	12.27	519.88	346.76	173.42
530	1°35.4′	4°12.81′	264.95	3.25	529.71	12.99	529.87	353.43	176.76
540	1°37.2′	4°22.44′	269.95	3.43	539.69	13.74	539.86	360.11	180.10
550	1°39.0′	4°32.25′	274.94	3.63	549.66	14.51	549.85	366.79	183.44
560	1°40.8′	4°42.24′	279.94	3.83	559.62	15.32	559.83	373.47	186.79
570	1°42.6′	4°52.41′	284.93	4.04	569.59	16.15	569.82	380.14	190.13
580	1°44.4′	5°02.76′	289.93	4.26	579.55	17.02	579.80	386.82	193.48
590	1°46.2′	5°13.29′	294.92	4.48	589.51	17.91	589.78	393.50	196.82
600	1°48.0′	5°24.00′	299.91	4.71	599.47	18.84	599.76	400.19	200.17
610	1°49.8′	5°34.89′	304.90	4.95	609.42	19.79	609.74	406.87	203.52
620	1°51.6′	5°45.96′	309.90	5.20	619.37	20.78	619.72	413.55	206.87
630	1°53.4′	5°57.21′	314.89	5.45	629.32	21.80	629.70	420.24	210.22
640	1°55.2′	6°08.64′	319.88	5.72	639.26	22.86	639.67	426.92	213.57
650	1°57.0′	6°20.25′	324.87	5.99	649.21	23.94	649.65	433.61	216.92
660	1°58.8′	6°32.04′	329.86	6.27	659.14	25.07	659.62	440.30	220.27
670	2°00.6′	6°44.01′	334.85	6.56	669.08	26.22	669.59	446.99	223.63
680	2°02.4′	6°56.16′	339.83	6.86	679.00	27.41	679.56	453.68	226.98
690	2°04.2′	7°08.49′	344.82	7.16	688.93	28.64	689.52	460.37	230.34
700	2°06.0′	7°21.00′	349.81	7.48	698.85	29.90	699.49	467.07	233.70
710	2°07.8′	7°33.69′	354.79	7.80	708.76	31.19	709.45	473.77	237.06
720	2°09.6′	7°46.56′	359.78	8.14	718.67	32.53	719.41	480.46	240.42
730	2°11.4′	7°59.61′	364.76	8.48	728.58	33.90	729.37	487.16	243.79
740	2°13.2′	8°12.84′	369.75	8.83	738.48	35.31	739.32	493.87	247.15
750	2°15.0′	8°26.25′	374.73	9.20	748.38	36.76	749.28	500.57	250.52
760	2°16.8′	8°39.84′	379.71	9.57	758.26	38.25	759.23	507.27	253.89
770	2°18.6′	8°53.61′	384.69	9.95	768.15	39.77	769.18	513.98	257.26
780	2°20.4′	9°07.56′	389.67	10.34	778.02	41.34	779.12	520.69	260.63
790	2°22.2′	9°21.69′	394.65	10.75	787.89	42.94	789.06	527.41	264.00
800	2°24.0′	9°36.00′	399.63	11.16	797.76	44.59	799.00	534.12	267.38
810	2°25.8′	9°50.49′	404.60	11.58	807.61	46.28	808.94	540.84	270.76
820	2°27.6′	10°05.16′	409.58	12.02	817.46	48.01	818.87	547.56	274.14
830	2°29.4′	10°20.01′	414.55	12.46	827.30	49.78	828.80	554.28	277.53
840	2°31.2′	10°35.04′	419.52	12.92	837.14	51.60	838.73	561.00	280.91
850	2°33.0′	10°50.25′	424.49	13.38	846.96	53.46	848.65	567.73	284.30
860	2°34.8′	11°05.64′	429.46	13.86	856.78	55.36	858.57	574.46	287.69
870	2°36.6′	11°21.21′	434.43	14.35	866.59	57.30	868.48	581.20	291.09
880	2°38.4′	11°36.96′	439.40	14.85	876.39	59.30	878.39	587.93	294.49
890	2°40.2′	11°52.89′	444.36	15.36	886.18	61.33	888.30	594.68	297.89
900	2°42.0′	12°09.00′	449.33	15.88	895.96	63.41	898.20	601.42	301.29
910	2°43.8′	12°25.29′	454.29	16.41	905.73	65.54	908.10	608.17	304.70
920	2°45.6′	12°41.76′	459.25	16.96	915.49	67.72	917.99	614.92	308.11
930	2°47.4′	12°58.41′	464.21	17.52	925.24	69.94	927.88	621.67	311.52
940	2°49.2′	13°15.24′	469.16	18.09	934.98	72.21	937.77	628.43	314.94
950	2°51.0′	13°32.25′	474.12	18.67	944.71	74.52	947.64	635.20	318.36
960	2°52.8′	13°49.44′	479.07	19.26	954.43	76.89	957.52	641.96	321.78
970	2°54.6′	14°06.81′	484.02	19.87	964.13	79.30	967.39	648.73	325.21
980	2°56.4′	14°24.36′	488.97	20.49	973.82	81.76	977.25	655.51	328.65
990	2°58.2′	14°42.09′	493.92	21.12	983.50	84.28	987.11	662.29	332.08
1000	3°00.0′	15°00.00′	498.86	21.76	993.17	86.84	996.96	669.08	335.52

THE STANDARD HIGHWAY SPIRAL

a = 0.4

L	D	S	q	p	Y	X	C	U	V
10	0°02.4′	0°00.12′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°04.8′	0°00.48′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°07.2′	0°01.08′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°09.6′	0°01.92′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°12.0′	0°03.00′	25.00	0.00	50.00	0.01	50.00	33.33	16.67
60	0°14.4′	0°04.32′	30.00	0.01	60.00	0.03	60.00	40.00	20.00
70	0°16.8′	0°05.88′	35.00	0.01	70.00	0.04	70.00	46.67	23.33
80	0°19.2′	0°07.68′	40.00	0.01	80.00	0.06	80.00	53.33	26.67
90	0°21.6′	0°09.72′	45.00	0.02	90.00	0.08	90.00	60.00	30.00
100	0°24.0′	0°12.00′	50.00	0.03	100.00	0.12	100.00	66.67	33.33
110	0°26.4′	0°14.52′	55.00	0.04	110.00	0.15	110.00	73.33	36.67
120	0°28.8′	0°17.28′	60.00	0.05	120.00	0.20	120.00	80.00	40.00
130	0°31.2′	0°20.28′	65.00	0.06	130.00	0.26	130.00	86.67	43.33
140	0°33.6′	0°23.52′	70.00	0.08	140.00	0.32	140.00	93.33	46.67
150	0°36.0′	0°27.00′	75.00	0.10	150.00	0.39	150.00	100.00	50.00
160	0°38.4′	0°30.72′	80.00	0.12	160.00	0.48	160.00	106.67	53.33
170	0°40.8′	0°34.68′	85.00	0.14	170.00	0.57	170.00	113.33	56.67
180	0°43.2′	0°38.88′	90.00	0.17	180.00	0.68	180.00	120.00	60.00
190	0°45.6′	0°43.32′	95.00	0.20	190.00	0.80	190.00	126.67	63.33
200	0°48.0′	0°48.00′	100.00	0.23	200.00	0.93	200.00	133.33	66.67
210	0°50.4′	0°52.92′	105.00	0.27	210.00	1.08	210.00	140.00	70.00
220	0°52.8′	0°58.08′	110.00	0.31	219.99	1.24	220.00	146.67	73.34
230	0°55.2′	1°03.48′	115.00	0.35	229.99	1.42	230.00	153.34	76.67
240	0°57.6′	1°09.12′	120.00	0.40	239.99	1.61	240.00	160.00	80.00
250	1°00.0′	1°15.00′	125.00	0.45	249.99	1.82	249.99	166.67	83.34
260	1°02.4′	1°21.12′	130.00	0.51	259.99	2.04	259.99	173.34	86.67
270	1°04.8′	1°27.48′	135.00	0.57	269.98	2.29	269.99	180.01	90.01
280	1°07.2′	1°34.08′	140.00	0.64	279.98	2.55	279.99	186.67	93.34
290	1°09.6′	1°40.92′	145.00	0.71	289.98	2.84	289.99	193.34	96.67
300	1°12.0′	1°48.00′	150.00	0.79	299.97	3.14	299.99	200.01	100.01
310	1°14.4′	1°55.32′	154.99	0.87	309.97	3.47	309.98	206.68	103.34
320	1°16.8′	2°02.88′	159.99	0.95	319.96	3.81	319.98	213.35	106.68
330	1°19.2′	2°10.68′	164.99	1.05	329.95	4.18	329.98	220.02	110.02
340	1°21.6′	2°18.72′	169.99	1.14	339.94	4.57	339.98	226.69	113.35
350	1°24.0′	2°27.00′	174.99	1.25	349.94	4.99	349.97	233.36	116.69
360	1°26.4′	2°35.52′	179.99	1.36	359.93	5.43	359.97	240.03	120.02
370	1°28.8′	2°44.28′	184.99	1.47	369.92	5.89	369.96	246.70	123.36
380	1°31.2′	2°53.28′	189.98	1.60	379.90	6.38	379.96	253.37	126.70
390	1°33.6′	3°02.52′	194.98	1.73	389.89	6.90	389.95	260.04	130.03
400	1°36.0′	3°12.00′	199.98	1.86	399.88	7.45	399.94	266.71	133.37
410	1°38.4′	3°21.72′	204.98	2.00	409.86	8.02	409.94	273.38	136.71
420	1°40.8′	3°31.68′	209.97	2.15	419.84	8.62	419.93	280.06	140.05
430	1°43.2′	3°41.88′	214.97	2.31	429.82	9.25	429.92	286.73	143.39
440	1°45.6′	3°52.32′	219.97	2.48	439.80	9.91	439.91	293.40	146.73
450	1°48.0′	4°03.00′	224.96	2.65	449.78	10.60	449.90	300.08	150.07
460	1°50.4′	4°13.92′	229.96	2.83	459.75	11.32	459.89	306.75	153.41
470	1°52.8′	4°25.08′	234.95	3.02	469.72	12.08	469.88	313.43	156.76
480	1°55.2′	4°36.48′	239.95	3.22	479.69	12.86	479.86	320.11	160.10
490	1°57.6′	4°48.12′	244.94	3.42	489.66	13.68	489.85	326.79	163.44
500	2°00.0′	5°00.00′	249.94	3.64	499.62	14.54	499.83	333.47	166.79

THE STANDARD HIGHWAY SPIRAL

a = 0.4—Continued

L	D	S	q	p	Y	X	C	U	V
510	2°02.4′	5°12.12′	254.93	3.86	509.58	15.43	509.81	340.15	170.13
520	2°04.8′	5°24.48′	259.92	4.09	519.54	16.35	519.79	346.83	173.48
530	2°07.2′	5°37.08′	264.92	4.33	529.49	17.31	529.77	353.51	176.83
540	2°09.6′	5°49.92′	269.91	4.58	539.44	18.31	539.75	360.20	180.18
550	2°12.0′	6°03.00′	274.90	4.84	549.39	19.34	549.73	366.88	183.53
560	2°14.4′	6°16.32′	279.89	5.11	559.33	20.42	559.70	373.57	186.88
570	2°16.8′	6°29.88′	284.88	5.38	569.27	21.53	569.67	380.26	190.23
580	2°19.2′	6°43.68′	289.87	5.67	579.20	22.68	579.64	386.95	193.59
590	2°21.6′	6°57.72′	294.85	5.97	589.13	23.87	589.61	393.64	196.94
600	2°24.0′	7°12.00′	299.84	6.28	599.05	25.10	599.58	400.33	200.30
610	2°26.4′	7°26.52′	304.83	6.60	608.97	26.38	609.54	407.03	203.66
620	2°28.8′	7°41.28′	309.81	6.93	618.88	27.70	619.50	413.72	207.02
630	2°31.2′	7°56.28′	314.80	7.27	628.79	29.05	629.46	420.42	210.38
640	2°33.6′	8°11.52′	319.78	7.62	638.69	30.46	639.42	427.12	213.75
650	2°36.0′	8°27.00′	324.76	7.98	648.59	31.90	649.37	433.83	217.12
660	2°38.4′	8°42.72′	329.75	8.36	658.48	33.40	659.32	440.53	220.49
670	2°40.8′	8°58.68′	334.73	8.74	668.36	34.93	669.27	447.24	223.86
680	2°43.2′	9°14.88′	339.70	9.14	678.23	36.52	679.21	453.95	227.23
690	2°45.6′	9°31.32′	344.68	9.55	688.10	38.15	689.15	460.67	230.61
700	2°48.0′	9°48.00′	349.66	9.97	697.95	39.83	699.09	467.38	233.99
710	2°50.4′	10°04.92′	354.63	10.40	707.80	41.55	709.02	474.10	237.37
720	2°52.8′	10°22.08′	359.61	10.84	717.65	43.33	718.95	480.83	240.75
730	2°55.2′	10°39.48′	364.58	11.30	727.48	45.15	728.88	487.55	244.14
740	2°57.6′	10°57.12′	369.55	11.77	737.30	47.03	738.80	494.28	247.53
750	3°00.0′	11°15.00′	374.52	12.25	747.11	48.95	748.72	501.01	250.92
760	3°02.4′	11°33.12′	379.49	12.75	756.92	50.93	758.63	507.75	254.32
770	3°04.8′	11°51.48′	384.45	13.26	766.71	52.96	768.54	514.49	257.72
780	3°07.2′	12°10.08′	389.41	13.78	776.49	55.04	778.44	521.23	261.12
790	3°09.6′	12°28.92′	394.38	14.32	786.26	57.17	788.33	527.98	264.53
800	3°12.0′	12°48.00′	399.34	14.87	796.02	59.36	798.23	534.73	267.94
810	3°14.4′	13°07.32′	404.29	15.43	805.76	61.60	808.11	541.49	271.36
820	3°16.8′	13°26.88′	409.25	16.01	815.49	63.90	817.99	548.25	274.78
830	3°19.2′	13°46.68′	414.20	16.60	825.21	66.26	827.87	555.02	278.20
840	3°21.6′	14°06.72′	419.15	17.20	834.92	68.67	837.74	561.79	281.63
850	3°24.0′	14°27.00′	424.10	17.82	844.61	71.13	847.60	568.57	285.06
860	3°26.4′	14°47.52′	429.05	18.46	854.29	73.66	857.46	575.35	288.50
870	3°28.8′	15°08.28′	433.99	19.11	863.95	76.24	867.30	582.14	291.94
880	3°31.2′	15°29.28′	438.93	19.77	873.59	78.88	877.15	588.93	295.39
890	3°33.6′	15°50.52′	443.87	20.45	883.22	81.58	886.98	595.73	298.84
900	3°36.0′	16°12.00′	448.80	21.15	892.83	84.34	896.81	602.53	302.30
910	3°38.4′	16°33.72′	453.74	21.86	902.43	87.16	906.63	609.34	305.77
920	3°40.8′	16°55.68′	458.66	22.58	912.00	90.04	916.44	616.16	309.24
930	3°43.2′	17°17.88′	463.59	23.32	921.56	92.98	926.24	622.99	312.72
940	3°45.6′	17°40.32′	468.51	24.08	931.10	95.99	936.03	629.82	316.20
950	3°48.0′	18°03.00′	473.43	24.85	940.61	99.06	945.82	636.66	319.69
960	3°50.4′	18°25.92′	478.35	25.64	950.11	102.19	955.59	643.50	323.19
970	3°52.8′	18°49.08′	483.26	26.45	959.59	105.38	965.36	650.36	326.69
980	3°55.2′	19°12.48′	488.17	27.27	969.04	108.64	975.11	657.22	330.20
990	3°57.6′	19°36.12′	493.08	28.11	978.48	111.96	984.86	664.09	333.72
1000	4°00.0′	20°00.00′	497.98	28.96	987.88	115.35	994.60	670.97	337.25

THE STANDARD HIGHWAY SPIRAL

a = 0.5

L	D	S	q	p	Y	X	C	U	V
10	0°03.0′	0°00.15′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°06.0′	0°00.60′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°09.0′	0°01.35′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°12.0′	0°02.40′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°15.0′	0°03.75′	25.00	0.00	50.00	0.02	50.00	33.33	16.67
60	0°18.0′	0°05.40′	30.00	0.01	60.00	0.03	60.00	40.00	20.00
70	0°21.0′	0°07.35′	35.00	0.01	70.00	0.05	70.00	46.67	23.33
80	0°24.0′	0°09.60′	40.00	0.02	80.00	0.07	80.00	53.33	26.67
90	0°27.0′	0°12.15′	45.00	0.03	90.00	0.11	90.00	60.00	30.00
100	0°30.0′	0°15.00′	50.00	0.04	100.00	0.15	100.00	66.67	33.33
110	0°33.0′	0°18.15′	55.00	0.05	110.00	0.19	110.00	73.33	36.67
120	0°36.0′	0°21.60′	60.00	0.06	120.00	0.25	120.00	80.00	40.00
130	0°39.0′	0°25.35′	65.00	0.08	130.00	0.32	130.00	86.67	43.33
140	0°42.0′	0°29.40′	70.00	0.10	140.00	0.40	140.00	93.33	46.67
150	0°45.0′	0°33.75′	75.00	0.12	150.00	0.49	150.00	100.00	50.00
160	0°48.0′	0°38.40′	80.00	0.15	160.00	0.60	160.00	106.67	53.33
170	0°51.0′	0°43.35′	85.00	0.18	170.00	0.71	170.00	113.33	56.67
180	0°54.0′	0°48.60′	90.00	0.21	180.00	0.85	180.00	120.00	60.00
190	0°57.0′	0°54.15′	95.00	0.25	190.00	1.00	190.00	126.67	63.33
200	1°00.0′	1°00.00′	100.00	0.29	199.99	1.16	200.00	133.34	66.67
210	1°03.0′	1°06.15′	105.00	0.34	209.99	1.35	210.00	140.00	70.00
220	1°06.0′	1°12.60′	110.00	0.39	219.99	1.55	220.00	146.67	73.34
230	1°09.0′	1°19.35′	115.00	0.44	229.99	1.77	229.99	153.34	76.67
240	1°12.0′	1°26.40′	120.00	0.50	239.98	2.01	239.99	160.01	80.00
250	1°15.0′	1°33.75′	125.00	0.57	249.98	2.27	249.99	166.67	83.34
260	1°18.0′	1°41.40′	130.00	0.64	259.98	2.56	259.99	173.34	86.67
270	1°21.0′	1°49.35′	135.00	0.72	269.97	2.86	269.99	180.01	90.01
280	1°24.0′	1°57.60′	139.99	0.80	279.97	3.19	279.99	186.68	93.34
290	1°27.0′	2°06.15′	144.99	0.89	289.96	3.55	289.98	193.35	96.68
300	1°30.0′	2°15.00′	149.99	0.98	299.96	3.93	299.98	200.02	100.01
310	1°33.0′	2°24.15′	154.99	1.08	309.95	4.33	309.98	206.69	103.35
320	1°36.0′	2°33.60′	159.99	1.19	319.94	4.77	319.97	213.36	106.69
330	1°39.0′	2°43.35′	164.99	1.31	329.93	5.23	329.97	220.03	110.02
340	1°42.0′	2°53.40′	169.99	1.43	339.91	5.72	339.96	226.70	113.36
350	1°45.0′	3°03.75′	174.98	1.56	349.90	6.23	349.96	233.37	116.70
360	1°48.0′	3°14.40′	179.98	1.70	359.88	6.78	359.95	240.04	120.04
370	1°51.0′	3°25.35′	184.98	1.84	369.87	7.37	369.94	246.71	123.38
380	1°54.0′	3°36.60′	189.97	1.99	379.85	7.98	379.93	253.39	126.71
390	1°57.0′	3°48.15′	194.97	2.16	389.83	8.62	389.92	260.06	130.05
400	2°00.0′	4°00.00′	199.97	2.33	399.81	9.31	399.91	266.73	133.40
410	2°03.0′	4°12.15′	204.96	2.51	409.78	10.02	409.90	273.41	136.74
420	2°06.0′	4°24.60′	209.96	2.69	419.75	10.77	419.89	280.09	140.08
430	2°09.0′	4°37.35′	214.95	2.89	429.72	11.56	429.88	286.76	143.42
440	2°12.0′	4°50.40′	219.95	3.10	439.69	12.38	439.86	293.44	146.77
450	2°15.0′	5°03.75′	224.94	3.31	449.65	13.25	449.84	300.12	150.11
460	2°18.0′	5°17.40′	229.93	3.54	459.61	14.15	459.83	306.80	153.46
470	2°21.0′	5°31.35′	234.93	3.77	469.56	15.09	469.81	313.49	156.81
480	2°24.0′	5°45.60′	239.92	4.02	479.52	16.07	479.78	320.17	160.15
490	2°27.0′	6°00.15′	244.91	4.28	489.46	17.10	489.76	326.85	163.50
500	2°30.0′	6°15.00′	249.90	4.54	499.41	18.17	499.74	333.54	166.86

THE STANDARD HIGHWAY SPIRAL

a = 0.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	2°33.0′	6°30.15′	254.89	4.82	509.34	19.28	509.71	340.23	170.21
520	2°36.0′	6°45.60′	259.88	5.11	519.28	20.43	519.66	346.92	173.56
530	2°39.0′	7°01.35′	264.87	5.41	529.20	21.63	529.65	353.61	176.92
540	2°42.0′	7°17.40′	269.85	5.72	539.13	22.88	539.61	360.31	180.28
550	2°45.0′	7°33.75′	274.84	6.05	549.04	24.17	549.57	367.00	183.64
560	2°48.0′	7°50.40′	279.83	6.38	558.95	25.51	559.53	373.70	187.00
570	2°51.0′	8°07.35′	284.81	6.73	568.86	26.90	569.49	380.40	190.36
580	2°54.0′	8°24.60′	289.79	7.09	578.75	28.33	579.44	387.10	193.73
590	2°57.0′	8°42.15′	294.77	7.46	588.64	29.82	589.40	393.81	197.10
600	3°00.0′	9°00.00′	299.75	7.85	598.52	31.36	599.34	400.52	200.47
610	3°03.0′	9°18.15′	304.73	8.25	608.39	32.95	609.29	407.23	203.85
620	3°06.0′	9°36.60′	309.71	8.66	618.26	34.59	619.23	413.94	207.22
630	3°09.0′	9°55.35′	314.69	9.08	628.11	36.29	629.16	420.66	210.60
640	3°12.0′	10°14.40′	319.66	9.52	637.96	38.04	639.09	427.38	213.98
650	3°15.0′	10°33.75′	324.63	9.97	647.79	39.85	649.02	434.11	217.37
660	3°18.0′	10°53.40′	329.60	10.44	657.62	41.71	658.94	440.84	220.76
670	3°21.0′	11°13.35′	334.57	10.92	667.43	43.62	668.86	447.57	224.15
680	3°24.0′	11°33.60′	339.54	11.42	677.24	45.60	678.77	454.30	227.55
690	3°27.0′	11°54.15′	344.50	11.93	687.03	47.63	688.68	461.04	230.95
700	3°30.0′	12°15.00′	349.47	12.45	696.81	49.72	698.58	467.79	234.35
710	3°33.0′	12°36.15′	354.43	12.99	706.57	51.88	708.47	474.54	237.76
720	3°36.0′	12°57.60′	359.39	13.55	716.32	54.09	718.36	481.29	241.16
730	3°39.0′	13°19.35′	364.34	14.12	726.06	56.36	728.25	488.05	244.59
740	3°42.0′	13°41.40′	369.30	14.70	735.79	58.70	738.12	494.82	248.02
750	3°45.0′	14°03.75′	374.25	15.31	745.49	61.10	747.99	501.59	251.44
760	3°48.0′	14°26.40′	379.20	15.93	755.19	63.56	757.86	508.36	254.88
770	3°51.0′	14°49.35′	384.14	16.56	764.86	66.08	767.71	515.14	258.31
780	3°54.0′	15°12.60′	389.09	17.21	774.52	68.67	777.56	521.93	261.76
790	3°57.0′	15°36.15′	394.03	17.88	784.16	71.33	787.40	528.73	265.21
800	4°00.0′	16°00.00′	398.96	18.57	793.78	74.05	797.23	535.53	268.66
810	4°03.0′	16°24.15′	403.90	19.27	803.39	76.84	807.05	542.34	272.13
820	4°06.0′	16°48.60′	408.83	19.99	812.97	79.70	816.87	549.15	275.59
830	4°09.0′	17°13.35′	413.75	20.72	822.53	82.63	826.67	555.98	279.07
840	4°12.0′	17°38.40′	418.68	21.48	832.07	85.62	836.47	562.81	282.55
850	4°15.0′	18°03.75′	423.60	22.25	841.59	86.69	846.25	569.64	286.04
860	4°18.0′	18°29.40′	428.51	23.04	851.09	91.82	856.03	576.49	289.54
870	4°21.0′	18°55.35′	433.42	23.85	860.56	95.03	865.79	583.35	293.05
880	4°24.0′	19°21.60′	438.33	24.68	870.01	98.31	875.54	590.21	296.56
890	4°27.0′	19°48.15′	443.23	25.52	879.43	101.66	885.28	597.09	300.08
900	4°30.0′	20°15.00′	448.13	26.39	888.82	105.09	895.01	603.97	303.62
910	4°33.0′	20°42.15′	453.03	27.27	898.19	108.58	904.73	610.87	307.16
920	4°36.0′	21°09.60′	457.92	28.18	907.53	112.16	914.44	617.77	310.71
930	4°39.0′	21°37.35′	462.80	29.10	916.84	115.80	924.13	624.69	314.27
940	4°42.0′	22°05.40′	467.68	30.04	926.12	119.53	933.80	631.62	317.84
950	4°45.0′	22°33.75′	472.56	31.00	935.37	123.33	943.47	638.56	321.42
960	4°48.0′	23°02.40′	477.42	31.98	944.59	127.20	953.12	645.51	325.01
970	4°51.0′	23°31.35′	482.29	32.99	953.78	131.15	962.75	652.47	328.62
980	4°54.0′	24°00.60′	487.15	34.01	962.93	135.18	972.37	659.45	332.23
990	4°57.0′	24°30.15′	492.00	35.05	972.05	139.29	981.98	666.44	335.86
1000	5°00.0′	25°00.00′	496.84	36.11	981.13	143.48	991.56	673.44	339.50

THE STANDARD HIGHWAY SPIRAL

a = 0.6

L	D	S	q	p	Y	X	C	U	V
10	0°03.6′	0°00.18′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°07.2′	0°00.72′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°10.8′	0°01.62′	15.00	0.00	30.00	0.00	30.00	20.00	10.00
40	0°14.4′	0°02.88′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°18.0′	0°04.50′	25.00	0.01	50.00	0.02	50.00	33.33	16.67
60	0°21.6′	0°06.48′	30.00	0.01	60.00	0.04	60.00	40.00	20.00
70	0°25.2′	0°08.82′	35.00	0.01	70.00	0.06	70.00	46.67	23.33
80	0°28.8′	0°11.52′	40.00	0.02	80.00	0.09	80.00	53.33	26.67
90	0°32.4′	0°14.58′	45.00	0.03	90.00	0.13	90.00	60.00	30.00
100	0°36.0′	0°18.00′	50.00	0.04	100.00	0.17	100.00	66.67	33.33
110	0°39.6′	0°21.78′	55.00	0.06	110.00	0.23	110.00	73.33	36.67
120	0°43.2′	0°25.92′	60.00	0.08	120.00	0.30	120.00	80.00	40.00
130	0°46.8′	0°30.42′	65.00	0.10	130.00	0.38	130.00	86.67	43.33
140	0°50.4′	0°35.28′	70.00	0.12	140.00	0.48	140.00	93.33	46.67
150	0°54.0′	0°40.50′	75.00	0.15	150.00	0.59	150.00	100.00	50.00
160	0°57.6′	0°46.08′	80.00	0.18	160.00	0.71	160.00	106.67	53.33
170	1°01.2′	0°52.02′	85.00	0.21	170.00	0.86	170.00	113.33	56.67
180	1°04.8′	0°58.32′	90.00	0.25	179.99	1.02	180.00	120.00	60.00
190	1°08.4′	1°04.98′	95.00	0.30	189.99	1.20	190.00	126.67	63.34
200	1°12.0′	1°12.00′	100.00	0.35	199.99	1.40	200.00	133.34	66.67
210	1°15.6′	1°19.38′	105.00	0.40	209.99	1.62	210.00	140.00	70.00
220	1°19.2′	1°27.12′	110.00	0.46	219.99	1.86	219.99	146.67	73.34
230	1°22.8′	1°35.22′	115.00	0.53	229.98	2.12	229.99	153.34	76.67
240	1°26.4′	1°43.68′	120.00	0.60	239.98	2.41	239.99	160.01	80.01
250	1°30.0′	1°52.50′	125.00	0.68	249.97	2.73	249.99	166.68	83.34
260	1°33.6′	2°01.68′	129.99	0.77	259.97	3.07	259.99	173.34	86.68
270	1°37.2′	2°11.22′	134.99	0.86	269.96	3.43	269.98	180.01	90.01
280	1°40.8′	2°21.12′	139.99	0.96	279.95	3.83	279.98	186.68	93.35
290	1°44.4′	2°31.38′	144.99	1.06	289.94	4.26	289.97	193.35	96.68
300	1°48.0′	2°42.00′	149.99	1.18	299.93	4.71	299.97	200.02	100.02
310	1°51.6′	2°52.98′	154.99	1.30	309.92	5.20	309.97	206.69	103.36
320	1°55.2′	3°04.32′	159.98	1.43	319.91	5.72	319.96	213.37	106.70
330	1°58.8′	3°16.02′	164.98	1.57	329.89	6.27	329.95	220.04	110.03
340	2°02.4′	3°28.08′	169.98	1.71	339.88	6.86	339.94	226.71	113.37
350	2°06.0′	3°40.50′	174.98	1.87	349.86	7.48	349.94	233.38	116.71
360	2°09.6′	3°53.28′	179.97	2.04	359.83	8.14	359.93	240.06	120.05
370	2°13.2′	4°06.42′	184.97	2.21	369.81	8.84	369.92	246.73	123.39
380	2°16.8′	4°19.92′	189.96	2.39	379.78	9.57	379.90	253.41	126.74
390	2°20.4′	4°33.78′	194.96	2.59	389.75	10.35	389.89	260.09	130.08
400	2°24.0′	4°48.00′	199.95	2.79	399.72	11.16	399.88	266.76	133.42
410	2°27.6′	5°02.58′	204.95	3.01	409.68	12.02	409.86	273.44	136.77
420	2°31.2′	5°17.52′	209.94	3.23	419.64	12.92	419.84	280.13	140.11
430	2°34.8′	5°32.82′	214.93	3.47	429.60	13.87	429.82	286.81	143.46
440	2°38.4′	5°48.48′	219.92	3.72	439.55	14.86	439.80	293.49	146.81
450	2°42.0′	6°04.50′	224.92	3.97	449.49	15.89	449.78	300.18	150.16
460	2°45.6′	6°20.88′	229.91	4.25	459.44	16.97	459.75	306.86	153.51
470	2°49.2′	6°37.62′	234.90	4.53	469.37	18.10	469.72	313.55	156.87
480	2°52.8′	6°54.72′	239.88	4.82	479.30	19.28	479.69	320.24	160.22
490	2°56.4′	7°12.18′	244.87	5.13	489.23	20.51	489.66	326.94	163.58
500	3°00.0′	7°30.00′	249.86	5.45	499.14	21.79	499.62	333.63	166.94

THE STANDARD HIGHWAY SPIRAL

a = 0.6—Continued

L	D	S	q	p	Y	X	C	U	V
510	3°03.6′	7°48.18′	254.84	5.78	509.05	23.12	509.58	340.33	170.30
520	3°07.2′	8°06.72′	259.83	6.13	518.96	24.51	519.54	347.03	173.66
530	3°10.8′	8°25.62′	264.81	6.49	528.85	25.94	529.49	353.73	177.03
540	3°14.4′	8°44.88′	269.79	6.86	538.74	27.44	539.44	360.44	180.40
550	3°18.0′	9°04.50′	274.77	7.25	548.62	28.99	549.39	367.15	183.77
560	3°21.6′	9°24.48′	279.75	7.66	558.49	30.59	559.33	373.86	187.15
570	3°25.2′	9°44.82′	284.73	8.07	568.35	32.26	569.27	380.58	190.53
580	3°28.8′	10°05.52′	289.70	8.50	578.20	33.98	579.20	387.30	193.91
590	3°32.4′	10°26.58′	294.67	8.95	588.04	35.76	589.13	394.02	197.29
600	3°36.0′	10°48.00′	299.65	9.41	597.87	37.60	599.05	400.75	200.68
610	3°39.6′	11°09.78′	304.61	9.89	607.69	39.51	608.97	407.48	204.07
620	3°43.2′	11°31.92′	309.58	10.38	617.49	41.48	618.88	414.21	207.47
630	3°46.8′	11°54.42′	314.55	10.89	627.28	43.51	628.79	420.95	210.87
640	3°50.4′	12°17.28′	319.51	11.42	637.06	45.60	638.69	427.70	214.27
650	3°54.0′	12°40.50′	324.47	11.96	646.83	47.76	648.59	434.45	217.68
660	3°57.6′	13°04.08′	329.43	12.52	656.57	49.99	658.48	441.20	221.10
670	4°01.2′	13°28.02′	334.38	13.10	666.31	52.29	668.36	447.97	224.52
680	4°04.8′	13°52.32′	339.34	13.69	676.02	54.65	678.23	454.73	227.94
690	4°08.4′	14°16.98′	344.29	14.30	685.72	57.08	688.10	461.51	231.37
700	4°12.0′	14°42.00′	349.23	14.93	695.41	59.58	697.95	468.29	234.81
710	4°15.6′	15°07.38′	354.18	15.58	705.07	62.16	707.80	475.07	238.25
720	4°19.2′	15°33.12′	359.12	16.24	714.71	64.80	717.65	481.87	241.70
730	4°22.8′	15°59.22′	364.05	16.93	724.34	67.52	727.48	488.67	245.15
740	4°26.4′	16°25.68′	368.99	17.63	733.94	70.31	737.30	495.47	248.61
750	4°30.0′	16°52.50′	373.92	18.35	743.52	73.18	747.11	502.29	252.08
760	4°33.6′	17°19.68′	378.84	19.09	753.08	76.12	756.92	509.12	255.56
770	4°37.2′	17°47.22′	383.77	19.85	762.61	79.13	766.71	515.95	259.05
780	4°40.8′	18°15.12′	388.68	20.63	772.12	82.23	776.49	522.79	262.54
790	4°44.4′	18°43.38′	393.60	21.43	781.61	85.40	786.26	529.64	266.04
800	4°48.0′	19°12.00′	398.51	22.25	791.06	88.65	796.01	536.50	269.55
810	4°51.6′	19°40.98′	403.41	23.09	800.49	91.97	805.76	543.38	273.07
820	4°55.2′	20°10.32′	408.31	23.95	809.89	95.38	815.49	550.26	276.60
830	4°58.8′	20°40.02′	413.21	24.83	819.27	98.87	825.21	557.15	280.14
840	5°02.4′	21°10.08′	418.10	25.74	828.61	102.44	834.92	564.06	283.69
850	5°06.0′	21°40.50′	422.98	26.66	837.92	106.09	844.61	570.97	287.25
860	5°09.6′	22°11.28′	427.86	27.60	847.19	109.83	854.28	577.90	290.83
870	5°13.2′	22°42.42′	432.73	28.57	856.43	113.65	863.94	584.84	294.41
880	5°16.8′	23°13.92′	437.60	29.56	865.64	117.55	873.59	591.80	298.01
890	5°20.4′	23°45.78′	442.46	30.57	874.81	121.54	883.21	598.77	301.61
900	5°24.0′	24°18.00′	447.32	31.61	883.95	125.61	892.83	605.75	305.24
910	5°27.6′	24°50.58′	452.16	32.66	893.04	129.77	902.42	612.75	308.87
920	5°31.2′	25°23.52′	457.00	33.74	902.09	134.01	911.99	619.76	312.52
930	5°34.8′	25°56.82′	461.84	34.84	911.11	138.34	921.55	626.79	316.19
940	5°38.4′	26°30.48′	466.67	35.97	920.08	142.76	931.09	633.84	319.86
950	5°42.0′	27°04.50′	471.49	37.11	929.00	147.27	940.61	640.90	323.56
960	5°45.6′	27°38.88′	476.30	38.28	937.89	151.87	950.10	647.98	327.27
970	5°49.2′	28°13.62′	481.10	39.48	946.72	156.55	959.58	655.08	331.00
980	5°52.8′	28°48.72′	485.90	40.70	955.51	161.33	969.03	662.20	334.74
990	5°56.4′	29°24.18′	490.69	41.94	964.24	166.19	978.46	669.34	338.51
1000	6°00.0′	30°00.00′	495.47	43.21	972.93	171.14	987.87	676.50	342.29

THE STANDARD HIGHWAY SPIRAL

a = 0.7

L	D	S	q	p	Y	X	C	U	V
10	0°04.2′	0°00.21′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°08.4′	0°00.84′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°12.6′	0°01.89′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°16.8′	0°03.36′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°21.0′	0°05.25′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0°25.2′	0°07.56′	30.00	0.01	60.00	0.04	60.00	40.00	20.00
70	0°29.4′	0°10.29′	35.00	0.02	70.00	0.07	70.00	46.67	23.33
80	0°33.6′	0°13.44′	40.00	0.03	80.00	0.10	80.00	53.33	26.67
90	0°37.8′	0°17.01′	45.00	0.04	90.00	0.15	90.00	60.00	30.00
100	0°42.0′	0°21.00′	50.00	0.05	100.00	0.20	100.00	66.67	33.33
110	0°46.2′	0°25.41′	55.00	0.07	110.00	0.27	110.00	73.33	36.67
120	0°50.4′	0°30.24′	60.00	0.09	120.00	0.35	120.00	80.00	40.00
130	0°54.6′	0°35.49′	65.00	0.11	130.00	0.45	130.00	86.67	43.33
140	0°58.8′	0°41.16′	70.00	0.14	140.00	0.56	140.00	93.33	46.67
150	1°03.0′	0°47.25′	75.00	0.17	150.00	0.69	150.00	100.00	50.00
160	1°07.2′	0°53.76′	80.00	0.21	160.00	0.83	160.00	106.67	53.33
170	1°11.4′	1°00.69′	85.00	0.25	169.99	1.00	170.00	113.34	56.67
180	1°15.6′	1°08.04′	90.00	0.30	179.99	1.19	180.00	120.00	60.00
190	1°19.8′	1°15.81′	95.00	0.35	189.99	1.40	190.00	126.67	63.34
200	1°24.0′	1°24.00′	100.00	0.41	199.99	1.63	199.99	133.34	66.67
210	1°28.2′	1°32.61′	105.00	0.47	209.98	1.89	209.99	140.01	70.00
220	1°32.4′	1°41.64′	110.00	0.54	219.98	2.17	219.99	146.67	73.34
230	1°36.6′	1°51.09′	115.00	0.62	229.98	2.48	229.99	153.34	76.67
240	1°40.8′	2°00.96′	120.00	0.70	239.97	2.81	239.99	160.01	80.01
250	1°45.0′	2°11.25′	124.99	0.80	249.96	3.18	249.98	166.63	83.34
260	1°49.2′	2°21.96′	129.99	0.89	259.96	3.58	259.98	173.35	86.68
270	1°53.4′	2°33.09′	134.99	1.00	269.95	4.01	269.98	180.02	90.02
280	1°57.6′	2°44.64′	139.99	1.12	279.94	4.47	279.97	186.69	93.35
290	2°01.8′	2°56.61′	144.99	1.24	289.92	4.97	289.97	193.36	96.69
300	2°06.0′	3°09.00′	149.98	1.37	299.91	5.50	299.96	200.03	100.03
310	2°10.2′	3°21.81′	154.98	1.52	309.89	6.06	309.95	206.70	103.37
320	2°14.4′	3°35.04′	159.98	1.67	319.87	6.67	319.94	213.38	106.71
330	2°18.6′	3°48.69′	164.98	1.83	329.85	7.32	329.94	220.05	110.05
340	2°22.8′	4°02.76′	169.97	2.00	339.83	8.00	339.92	226.73	113.39
350	2°27.0′	4°17.25′	174.97	2.18	349.80	8.73	349.91	233.40	116.73
360	2°31.2′	4°32.16′	179.96	2.37	359.77	9.50	359.90	240.08	120.07
370	2°35.4′	4°47.49′	184.96	2.58	369.74	10.31	369.88	246.76	123.42
380	2°39.6′	5°03.24′	189.95	2.79	379.70	11.17	379.87	253.44	126.76
390	2°43.8′	5°19.41′	194.94	3.02	389.66	12.07	389.85	260.12	130.11
400	2°48.0′	5°36.00′	199.94	3.26	399.62	13.02	399.83	266.80	133.45
410	2°52.2′	5°53.01′	204.93	3.51	409.57	14.02	409.81	273.48	136.80
420	2°56.4′	6°10.44′	209.92	3.77	419.51	15.07	419.78	280.17	140.15
430	3°00.6′	6°28.29′	214.91	4.05	429.45	16.17	429.76	286.86	143.51
440	3°04.8′	6°46.56′	219.90	4.33	439.38	17.33	439.73	293.55	146.86
450	3°09.0′	7°05.25′	224.89	4.64	449.31	18.53	449.69	300.24	150.22
460	3°13.2′	7°24.36′	229.87	4.95	459.23	19.80	459.66	306.94	153.58
470	3°17.4′	7°43.89′	234.86	5.28	469.14	21.11	469.62	313.63	156.94
480	3°21.6′	8°03.84′	239.84	5.63	479.05	22.49	479.58	320.33	160.30
490	3°25.8′	8°24.21′	244.82	5.98	488.95	23.92	489.53	327.04	163.67
500	3°30.0′	8°45.00′	249.81	6.36	498.84	25.41	499.48	333.74	167.04

THE STANDARD HIGHWAY SPIRAL

a = 0.7—Continued

L	D	S	q	p	Y	X	C	U	V
510	3°34.2′	9°06.21′	254.79	6.75	508.71	26.96	509.43	340.45	170.41
520	3°38.4′	9°27.84′	259.76	7.15	518.58	28.58	519.37	347.16	173.78
530	3°42.6′	9°49.89′	264.74	7.57	528.44	30.25	529.31	353.88	177.16
540	3°46.8′	10°12.36′	269.71	8.01	538.29	31.99	539.24	360.60	180.55
550	3°51.0′	10°35.25′	274.69	8.46	548.12	33.80	549.17	367.32	183.93
560	3°55.2′	10°58.56′	279.66	8.93	557.95	35.67	559.09	374.05	187.32
570	3°59.4′	11°22.29′	284.63	9.41	567.76	37.60	569.00	380.79	190.72
580	4°03.6′	11°46.44′	289.59	9.92	577.56	39.61	578.91	387.53	194.11
590	4°07.8′	12°11.01′	294.56	10.44	587.34	41.68	588.82	394.27	197.52
600	4°12.0′	12°36.00′	299.52	10.98	597.10	43.83	598.71	401.02	200.93
610	4°16.2′	13°01.41′	304.48	11.53	606.86	46.05	608.60	407.77	204.34
620	4°20.4′	13°27.24′	309.43	12.11	616.59	48.34	618.48	414.53	207.76
630	4°24.6′	13°53.49′	314.38	12.70	626.31	50.70	628.36	421.30	211.18
640	4°28.8′	14°20.16′	319.33	13.31	636.00	53.14	638.22	428.07	214.61
650	4°33.0′	14°47.25′	324.23	13.95	645.68	55.65	648.08	434.85	218.05
660	4°37.2′	15°14.76′	329.22	14.60	655.34	58.25	657.93	441.64	221.49
670	4°41.4′	15°42.69′	334.16	15.27	664.98	60.91	667.76	448.44	224.95
680	4°45.6′	16°11.04′	339.10	15.96	674.59	63.66	677.59	455.24	228.40
690	4°49.8′	16°39.81′	344.03	16.67	684.19	66.49	687.41	462.05	231.87
700	4°54.0′	17°09.00′	348.96	17.40	693.75	69.40	697.22	468.88	235.34
710	4°58.2′	17°38.61′	353.88	18.16	703.30	72.39	707.01	475.71	238.83
720	5°02.4′	18°08.64′	358.80	18.93	712.81	75.46	716.80	482.55	242.32
730	5°06.6′	18°39.09′	363.71	19.73	722.30	78.61	726.57	489.40	245.82
740	5°10.8′	19°09.96′	368.62	20.55	731.76	81.86	736.33	496.26	249.33
750	5°15.0′	19°41.25′	373.53	21.39	741.19	85.18	746.07	503.13	252.85
760	5°19.2′	20°12.96′	378.43	22.25	750.59	88.59	755.80	510.01	256.38
770	5°23.4′	20°45.09′	383.32	23.13	759.96	92.09	765.52	516.91	259.92
780	5°27.6′	21°17.64′	388.21	24.04	769.29	95.68	775.22	523.81	263.47
790	5°31.8′	21°50.61′	393.09	24.97	778.59	99.36	784.91	530.73	267.03
800	5°36.0′	22°24.00′	397.97	25.92	787.86	103.12	794.58	537.67	270.61
810	5°40.2′	22°57.81′	402.84	26.90	797.09	106.98	804.23	544.61	274.20
820	5°44.4′	23°32.04′	407.71	27.90	806.27	110.92	813.87	551.58	277.80
830	5°48.6′	24°06.69′	412.56	28.92	815.42	114.96	823.49	558.55	281.42
840	5°52.8′	24°41.76′	417.41	29.97	824.53	119.10	833.08	565.55	285.05
850	5°57.0′	25°17.25′	422.26	31.05	833.59	123.32	842.66	572.56	288.70
860	6°01.2′	25°53.16′	427.09	32.14	842.61	127.64	852.22	579.59	292.36
870	6°05.4′	26°29.49′	431.92	33.27	851.58	132.05	861.76	586.63	296.04
880	6°09.6′	27°06.24′	436.74	34.41	860.51	136.56	871.28	593.69	299.73
890	6°13.8′	27°43.41′	441.55	35.59	869.39	141.16	880.77	600.78	303.45
900	6°18.0′	28°21.00′	446.35	36.79	878.21	145.86	890.24	607.88	307.18
910	6°22.2′	28°59.01′	451.15	38.01	886.99	150.66	899.69	615.00	310.93
920	6°26.4′	29°37.44′	455.93	39.26	895.71	155.56	909.12	622.15	314.70
930	6°30.6′	30°16.29′	460.71	40.54	904.37	160.55	918.51	629.31	318.49
940	6°34.8′	30°55.56′	465.47	41.84	912.98	165.64	927.88	636.50	322.30
950	6°39.0′	31°35.25′	470.23	43.17	921.53	170.83	937.23	643.72	326.13
960	6°43.2′	32°15.36′	474.97	44.53	930.02	176.11	946.55	650.96	329.98
970	6°47.4′	32°55.89′	479.71	45.92	938.44	181.50	955.83	658.22	333.86
980	6°51.6′	33°36.84′	484.43	47.33	946.80	186.99	965.09	665.51	337.77
990	6°55.8′	34°18.21′	489.14	48.77	955.10	192.57	974.32	672.83	341.70
1000	7°00.0′	35°00.00′	493.84	50.23	963.32	198.26	983.51	680.18	345.65

THE STANDARD HIGHWAY SPIRAL

a = 0.8

L	D	S	q	p	Y	X	C	U	V
10	0°04.8′	0°00.24′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°09.6′	0°00.96′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°14.4′	0°02.16′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°19.2′	0°03.84′	20.00	0.00	40.00	0.01	40.00	26.67	13.33
50	0°24.0′	0°06.00′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0°28.8′	0°08.64′	30.00	0.01	60.00	0.05	60.00	40.00	20.00
70	0°33.6′	0°11.76′	35.00	0.02	70.00	0.08	70.00	46.67	23.33
80	0°38.4′	0°15.36′	40.00	0.03	80.00	0.12	80.00	53.33	26.67
90	0°43.2′	0°19.44′	45.00	0.04	90.00	0.17	90.00	60.00	30.00
100	0°48.0′	0°24.00′	50.00	0.06	100.00	0.23	100.00	66.67	33.33
110	0°52.8′	0°29.04′	55.00	0.08	110.00	0.31	110.00	73.33	36.67
120	0°57.6′	0°34.56′	60.00	0.10	120.00	0.40	120.00	80.00	40.00
130	1°02.4′	0°40.56′	65.00	0.13	130.00	0.51	130.00	86.67	43.33
140	1°07.2′	0°47.04′	70.00	0.16	140.00	0.64	140.00	93.33	46.67
150	1°12.0′	0°54.00′	75.00	0.20	150.00	0.79	150.00	100.00	50.00
160	1°16.8′	1°01.44′	80.00	0.24	159.99	0.95	160.00	106.67	53.33
170	1°21.6′	1°09.36′	85.00	0.29	169.99	1.14	170.00	113.34	56.67
180	1°26.4′	1°17.76′	90.00	0.34	179.99	1.36	180.00	120.00	60.00
190	1°31.2′	1°26.64′	95.00	0.40	189.99	1.60	189.99	126.67	63.34
200	1°36.0′	1°36.00′	100.00	0.47	199.98	1.86	199.99	133.34	66.67
210	1°40.8′	1°45.84′	105.00	0.54	209.98	2.15	209.99	140.01	70.01
220	1°45.6′	1°56.16′	110.00	0.62	219.97	2.48	219.99	146.68	73.34
230	1°50.4′	2°06.96′	114.99	0.71	229.97	2.83	229.99	153.34	76.68
240	1°55.2′	2°18.24′	119.99	0.80	239.96	3.22	239.98	160.01	80.01
250	2°00.0′	2°30.00′	124.99	0.91	249.95	3.64	249.98	166.68	83.35
260	2°04.8′	2°42.24′	129.99	1.02	259.94	4.09	259.97	173.35	86.69
270	2°09.6′	2°54.96′	134.99	1.14	269.93	4.58	269.97	180.02	90.02
280	2°14.4′	3°08.16′	139.99	1.28	279.92	5.11	279.96	186.70	93.36
290	2°19.2′	3°21.84′	144.98	1.42	289.90	5.67	289.96	193.37	96.70
300	2°24.0′	3°36.00′	149.98	1.57	299.88	6.28	299.95	200.04	100.04
310	2°28.8′	3°50.64′	154.98	1.73	309.86	6.93	309.94	206.72	103.38
320	2°33.6′	4°05.76′	159.97	1.91	319.84	7.62	319.93	213.39	106.72
330	2°38.4′	4°21.36′	164.97	2.09	329.81	8.36	329.92	220.07	110.06
340	2°43.2′	4°37.44′	169.96	2.29	339.78	9.14	339.90	226.74	113.40
350	2°48.0′	4°54.00′	174.96	2.49	349.74	9.97	349.89	233.42	116.75
360	2°52.8′	5°11.04′	179.95	2.71	359.71	10.85	359.87	240.10	120.09
370	2°57.6′	5°28.56′	184.94	2.95	369.66	11.78	369.85	246.78	123.44
380	3°02.4′	5°46.56′	189.94	3.19	379.61	12.76	379.83	253.47	126.79
390	3°07.2′	6°05.04′	194.93	3.45	389.56	13.79	389.80	260.15	130.14
400	3°12.0′	6°24.00′	199.92	3.72	399.50	14.88	399.78	266.84	133.49
410	3°16.8′	6°43.44′	204.91	4.01	409.44	16.02	409.75	273.53	136.85
420	3°21.6′	7°03.36′	209.89	4.31	419.36	17.22	419.72	280.22	140.20
430	3°26.4′	7°23.76′	214.88	4.62	429.28	18.48	429.68	286.92	143.56
440	3°31.2′	7°44.64′	219.87	4.95	439.20	19.80	439.64	293.61	146.92
450	3°36.0′	8°06.00′	224.85	5.30	449.10	21.18	449.60	300.31	150.29
460	3°40.8′	8°27.84′	229.83	5.66	459.00	22.62	459.55	307.02	153.65
470	3°45.6′	8°50.16′	234.81	6.04	468.88	24.12	469.50	313.72	157.02
480	3°50.4′	9°12.96′	239.79	6.43	478.76	25.69	479.45	320.43	160.40
490	3°55.2′	9°36.24′	244.77	6.84	488.63	27.32	489.39	327.15	163.77
500	4°00.0′	10°00.00′	249.75	7.26	498.48	29.03	499.32	333.87	167.15

THE STANDARD HIGHWAY SPIRAL

a = 0.8—Continued

L	D	S	q	p	Y	X	C	U	V
510	4°04.8′	10°24.24′	254.72	7.71	508.32	30.80	509.25	340.59	170.54
520	4°09.6′	10°48.96′	259.69	8.17	518.15	32.64	519.18	347.32	173.92
530	4°14.4′	11°14.16′	264.66	8.65	527.97	34.55	529.09	354.05	177.32
540	4°19.2′	11°39.84′	269.63	9.15	537.77	36.54	539.01	360.78	180.71
550	4°24.0′	12°06.00′	274.59	9.66	547.55	38.59	548.91	367.53	184.12
560	4°28.8′	12°32.64′	279.55	10.20	557.32	40.73	558.81	374.27	187.52
570	4°33.6′	12°59.76′	284.51	10.75	567.07	42.94	568.70	381.03	190.94
580	4°38.4′	13°27.36′	289.47	11.33	576.81	45.23	578.58	387.79	194.35
590	4°43.2′	13°55.44′	294.42	11.92	586.53	47.59	588.45	394.56	197.78
600	4°48.0′	14°24.00′	299.37	12.54	596.22	50.04	598.32	401.33	201.21
610	4°52.8′	14°53.04′	304.32	13.17	605.90	52.57	608.17	408.11	204.65
620	4°57.6′	15°22.56′	309.26	13.83	615.55	55.18	618.02	414.90	208.09
630	5°02.4′	15°52.56′	314.20	14.51	625.18	57.87	627.85	421.70	211.55
640	5°07.2′	16°23.04′	319.13	15.21	634.79	60.65	637.68	428.51	215.01
650	5°12.0′	16°54.00′	324.06	15.93	644.37	63.51	647.49	435.32	218.48
660	5°16.8′	17°25.44′	328.99	16.67	653.92	66.46	657.29	442.15	221.96
670	5°21.6′	17°57.36′	333.91	17.44	663.45	69.50	667.08	448.99	225.44
680	5°26.4′	18°29.76′	338.82	18.22	672.95	72.63	676.86	455.83	228.94
690	5°31.2′	19°02.64′	343.73	19.04	682.42	75.85	686.62	462.69	232.45
700	5°36.0′	19°36.00′	348.64	19.87	691.85	79.15	696.37	469.56	235.97
710	5°40.8′	20°09.84′	353.54	20.73	701.26	82.56	706.10	476.44	239.49
720	5°45.6′	20°44.16′	358.43	21.61	710.63	86.05	715.82	483.34	243.03
730	5°50.4′	21°18.96′	363.32	22.52	719.96	89.64	725.52	490.24	246.59
740	5°55.2′	21°54.24′	368.20	23.45	729.26	93.32	735.20	497.16	250.15
750	6°00.0′	22°30.00′	373.08	24.41	738.52	97.10	744.87	504.10	253.73
760	6°04.8′	23°06.24′	377.95	25.39	747.73	100.97	754.52	511.05	257.32
770	6°09.6′	23°42.96′	382.81	26.40	756.91	104.95	764.15	518.02	260.93
780	6°14.4′	24°20.16′	387.67	27.43	766.05	109.02	773.76	525.00	264.55
790	6°19.2′	24°57.84′	392.51	28.49	775.13	113.19	783.35	532.00	268.19
800	6°24.0′	25°36.00′	397.35	29.58	784.18	117.46	792.92	539.02	271.84
810	6°23.8′	26°14.64′	402.18	30.69	793.17	121.83	802.47	546.06	275.51
820	6°33.6′	26°53.76′	407.01	31.83	802.11	126.30	812.00	553.11	279.20
830	6°38.4′	27°33.36′	411.82	32.99	811.01	130.88	821.50	560.19	282.91
840	6°43.2′	28°13.44′	416.63	34.18	819.84	135.56	830.98	567.29	286.64
850	6°48.0′	28°54.00′	421.42	35.41	828.63	140.34	840.43	574.41	290.38
860	6°52.8′	29°35.04′	426.21	36.65	837.35	145.22	849.85	581.55	294.15
870	6°57.6′	30°16.56′	430.98	37.93	846.02	150.21	859.25	588.72	297.94
880	7°02.4′	30°58.56′	435.75	39.24	854.62	155.31	868.62	595.91	301.75
890	7°07.2′	31°41.04′	440.50	40.57	863.17	160.51	877.96	603.12	305.59
900	7°12.0′	32°24.00′	445.25	41.93	871.64	165.81	887.27	610.37	309.45
910	7°16.8′	33°07.44′	449.98	43.32	880.05	171.22	896.55	617.64	313.33
920	7°21.6′	33°51.36′	454.70	44.74	888.39	176.74	905.80	624.94	317.24
930	7°26.4′	34°35.76′	459.41	46.19	896.66	182.36	915.02	632.27	321.18
940	7°31.2′	35°20.64′	464.10	47.67	904.86	188.10	924.20	639.63	325.15
950	7°36.0′	36°06.00′	468.78	49.18	912.97	193.93	933.34	647.02	329.15
960	7°40.8′	36°51.84′	473.45	50.72	921.01	199.88	942.45	654.45	333.18
970	7°45.6′	37°38.16′	478.11	52.29	928.97	205.93	951.53	661.91	337.24
980	7°50.4′	38°24.96′	482.75	53.89	936.85	212.09	960.56	669.41	341.33
990	7°55.2′	39°12.24′	487.37	55.52	944.64	218.36	969.55	676.95	345.46
1000	8°00.0′	40°00.00′	491.99	57.18	952.35	224.73	978.51	684.52	349.62

THE STANDARD HIGHWAY SPIRAL

a = 0.9

L	D	S	q	p	Y	X	C	U	V
10	0°05.4′	0°00.27′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°10.8′	0°01.08′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°16.2′	0°02.43′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°21.6′	0°04.32′	20.00	0.00	40.00	0.02	40.00	26.67	13.33
50	0°27.0′	0°06.75′	25.00	0.01	50.00	0.03	50.00	33.33	16.67
60	0°32.4′	0°09.72′	30.00	0.01	60.00	0.06	60.00	40.00	20.00
70	0°37.8′	0°13.23′	35.00	0.02	70.00	0.09	70.00	46.67	23.33
80	0°43.2′	0°17.28′	40.00	0.03	80.00	0.13	80.00	53.33	26.67
90	0°48.6′	0°21.87′	45.00	0.05	90.00	0.19	90.00	60.00	30.00
100	0°54.0′	0°27.00′	50.00	0.07	100.00	0.26	100.00	66.67	33.33
110	0°59.4′	0°32.67′	55.00	0.09	110.00	0.35	110.00	73.33	36.67
120	1°04.8′	0°38.88′	60.00	0.11	120.00	0.45	120.00	80.00	40.00
130	1°10.2′	0°45.63′	65.00	0.14	130.00	0.58	130.00	86.67	43.33
140	1°15.6′	0°52.92′	70.00	0.18	140.00	0.72	140.00	93.33	46.67
150	1°21.0′	1°00.75′	75.00	0.22	150.00	0.88	150.00	100.00	50.00
160	1°26.4′	1°09.12′	80.00	0.27	159.99	1.07	160.00	106.67	53.34
170	1°31.8′	1°18.03′	85.00	0.32	169.99	1.29	170.00	113.34	56.67
180	1°37.2′	1°27.48′	90.00	0.38	179.99	1.53	179.99	120.00	60.00
190	1°42.6′	1°37.47′	95.00	0.45	189.98	1.80	189.99	126.67	63.34
200	1°48.0′	1°48.00′	100.00	0.52	199.98	2.09	199.99	133.34	66.67
210	1°53.4′	1°59.07′	105.00	0.61	209.97	2.42	209.99	140.01	70.01
220	1°58.8′	2°10.68′	109.99	0.70	219.97	2.79	219.99	146.68	73.34
230	2°04.2′	2°22.83′	114.99	0.80	229.96	3.18	229.98	153.35	76.68
240	2°09.6′	2°35.52′	119.99	0.90	239.95	3.62	239.98	160.02	80.02
250	2°15.0′	2°48.75′	124.99	1.02	249.94	4.09	249.97	166.69	83.35
260	2°20.4′	3°02.52′	129.99	1.15	259.93	4.60	259.97	173.36	86.69
270	2°25.8′	3°16.83′	134.99	1.29	269.91	5.15	269.96	180.03	90.03
280	2°31.2′	3°31.68′	139.98	1.44	279.89	5.75	279.95	186.70	93.37
290	2°36.6′	3°47.07′	144.98	1.60	289.87	6.38	289.94	193.38	96.71
300	2°42.0′	4°03.00′	149.98	1.77	299.85	7.07	299.93	200.05	100.05
310	2°47.4′	4°19.47′	154.97	1.95	309.82	7.80	309.92	206.73	103.39
320	2°52.8′	4°36.48′	159.97	2.14	319.79	8.57	319.91	213.41	106.73
330	2°58.2′	4°54.03′	164.96	2.35	329.76	9.40	329.89	220.08	110.08
340	3°03.6′	5°12.12′	169.95	2.57	339.72	10.28	339.88	226.76	113.42
350	3°09.0′	5°30.75′	174.95	2.81	349.68	11.22	349.86	233.45	116.77
360	3°14.4′	5°49.92′	179.94	3.05	359.63	12.21	359.83	240.13	120.12
370	3°19.8′	6°09.63′	184.93	3.31	369.57	13.25	369.81	246.82	123.47
380	3°25.2′	6°29.88′	189.92	3.59	379.51	14.35	379.78	253.50	126.82
390	3°30.6′	6°50.67′	194.91	3.88	389.44	15.51	389.75	260.19	130.18
400	3°36.0′	7°12.00′	199.89	4.19	399.37	16.74	399.72	266.89	133.53
410	3°41.4′	7°33.87′	204.88	4.51	409.29	18.02	409.68	273.58	136.89
420	3°46.8′	7°56.28′	209.87	4.85	419.19	19.37	419.64	280.28	140.26
430	3°52.2′	8°19.23′	214.85	5.20	429.09	20.78	429.60	286.98	143.62
440	3°57.6′	8°42.72′	219.83	5.57	438.98	22.26	439.55	293.69	146.99
450	4°03.0′	9°06.75′	224.81	5.96	448.86	23.81	449.49	300.40	150.36
460	4°08.4′	9°31.32′	229.79	6.36	458.73	25.43	459.44	307.11	153.74
470	4°13.8′	9°56.43′	234.76	6.79	468.59	27.12	469.37	313.83	157.12
480	4°19.2′	10°22.08′	239.74	7.23	478.43	28.89	479.30	320.55	160.50
490	4°24.6′	10°48.27′	244.71	7.69	488.26	30.72	489.23	327.28	163.89
500	4°30.0′	11°15.00′	249.68	8.17	498.08	32.63	499.14	334.01	167.28

THE STANDARD HIGHWAY SPIRAL

a = 0.9—Continued

L	D	S	q	p	Y	X	C	U	V
510	4°35.4′	11°42.27′	254.65	8.67	507.88	34.62	509.05	340.75	170.68
520	4°40.8′	12°10.08′	259.61	9.19	517.66	36.69	518.96	347.49	174.08
530	4°46.2′	12°38.43′	264.57	9.73	527.43	38.84	528.85	354.24	177.49
540	4°51.6′	13°07.32′	269.53	10.29	537.17	41.07	538.74	360.99	180.90
550	4°57.0′	13°36.75′	274.48	10.87	546.90	43.38	548.62	367.76	184.32
560	5°02.4′	14°06.72′	279.43	11.47	556.61	45.78	558.49	374.53	187.75
570	5°07.8′	14°37.23′	284.38	12.09	566.30	48.26	568.35	381.30	191.19
580	5°13.2′	15°08.28′	289.33	12.74	575.96	50.83	578.20	388.09	194.63
590	5°18.6′	15°39.87′	294.27	13.41	585.61	53.48	588.04	394.88	198.08
600	5°24.0′	16°12.00′	299.20	14.10	595.22	56.23	597.87	401.69	201.54
610	5°29.4′	16°44.67′	304.13	14.81	604.81	59.06	607.69	408.50	205.00
620	5°34.8′	17°17.88′	309.06	15.55	614.37	61.99	617.49	415.32	208.48
630	5°40.2′	17°51.63′	313.98	16.31	623.91	65.01	627.28	422.16	211.96
640	5°45.6′	18°25.92′	318.90	17.09	633.41	68.12	637.06	429.00	215.46
650	5°51.0′	19°00.75′	323.81	17.90	642.88	71.33	646.82	435.86	218.96
660	5°56.4′	19°36.12′	328.72	18.74	652.32	74.64	656.57	442.73	222.48
670	6°01.8′	20°12.03′	333.62	19.60	661.72	78.04	666.31	449.61	226.01
680	6°07.2′	20°48.48′	338.51	20.48	671.09	81.55	676.02	456.51	229.55
690	6°12.6′	21°25.47′	343.40	21.39	680.41	85.15	685.72	463.41	233.11
700	6°18.0′	22°03.00′	348.28	22.33	689.70	88.85	695.40	470.34	236.68
710	6°23.4′	22°41.07′	353.15	23.29	698.95	92.66	705.07	477.28	240.26
720	6°28.8′	23°19.68′	358.02	24.28	708.16	96.57	714.71	484.24	243.85
730	6°34.2′	23°58.83′	362.88	25.30	717.32	100.58	724.33	491.21	247.47
740	6°39.6′	24°38.52′	367.73	26.35	726.43	104.69	733.93	498.20	251.10
750	6°45.0′	25°18.75′	372.57	27.42	735.49	108.92	743.51	505.21	254.74
760	6°50.4′	25°59.52′	377.41	28.52	744.51	113.25	753.07	512.24	258.41
770	6°55.8′	26°40.83′	382.23	29.65	753.47	117.68	762.60	519.29	262.09
780	7°01.2′	27°22.68′	387.05	30.81	762.38	122.23	772.11	526.36	265.79
790	7°06.6′	28°05.07′	391.86	31.99	771.23	126.88	781.60	533.45	269.51
800	7°12.0′	28°48.00′	396.65	33.21	780.02	131.64	791.05	540.57	273.25
810	7°17.4′	29°31.47′	401.44	34.45	788.75	136.51	800.48	547.71	277.02
820	7°22.8′	30°15.48′	406.23	35.73	797.42	141.50	809.88	554.87	280.81
830	7°28.2′	31°00.03′	410.98	37.03	806.03	146.59	819.25	562.06	284.62
840	7°33.6′	31°45.12′	415.74	38.37	814.57	151.80	828.59	569.28	288.46
850	7°39.0′	32°30.75′	420.48	39.74	823.04	157.12	837.90	576.53	292.32
860	7°44.4′	33°16.92′	425.21	41.13	831.43	162.55	847.17	583.81	296.21
870	7°49.8′	34°03.63′	429.93	42.56	839.75	168.09	856.41	591.11	300.13
880	7°55.2′	34°50.88′	434.63	44.02	848.00	173.75	865.62	598.45	304.08
890	8°00.6′	35°38.67′	439.32	45.51	856.17	179.52	874.78	605.83	308.06
900	8°06.0′	36°27.00′	444.00	47.03	864.25	185.41	883.92	613.23	312.07
910	8°11.4′	37°15.87′	448.66	48.58	872.25	191.40	893.01	620.68	316.11
920	8°16.8′	38°05.28′	453.31	50.17	880.17	197.52	902.06	628.16	320.19
930	8°22.2′	38°55.23′	457.94	51.79	887.99	203.74	911.07	635.68	324.30
940	8°27.6′	39°45.72′	462.55	53.44	895.73	210.08	920.03	643.24	328.45
950	8°33.0′	40°36.75′	467.15	55.12	903.37	216.53	928.96	650.85	332.65
960	8°38.4′	41°28.32′	471.74	56.83	910.91	223.10	937.83	658.49	336.88
970	8°43.8′	42°20.43′	476.30	58.58	918.35	229.78	946.66	666.19	341.15
980	8°49.2′	43°13.08′	480.85	60.36	925.69	236.57	955.44	673.93	345.47
990	8°54.6′	44°06.27′	485.38	62.18	932.93	243.47	964.17	681.72	349.83
1000	9°00.0′	45°00.00′	489.89	64.03	940.05	250.49	972.85	689.56	354.24

THE STANDARD HIGHWAY SPIRAL

a = 1.0

L	D	S	q	p	Y	X	C	U	V
10	0°06.0′	0°00.30′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°12.0′	0°01.20′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°18.0′	0°02.70′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°24.0′	0°04.80′	20.00	0.00	40.00	0.02	40.00	26.67	13.33
50	0°30.0′	0°07.50′	25.00	0.01	50.00	0.04	50.00	33.33	16.67
60	0°36.0′	0°10.80′	30.00	0.02	60.00	0.06	60.00	40.00	20.00
70	0°42.0′	0°14.70′	35.00	0.02	70.00	0.10	70.00	46.67	23.33
80	0°48.0′	0°19.20′	40.00	0.04	80.00	0.15	80.00	53.33	26.67
90	0°54.0′	0°24.30′	45.00	0.05	90.00	0.21	90.00	60.00	30.00
100	1°00.0′	0°30.00′	50.00	0.07	100.00	0.29	100.00	66.67	33.33
110	1°06.0′	0°36.30′	55.00	0.10	110.00	0.39	110.00	73.33	36.67
120	1°12.0′	0°43.20′	60.00	0.13	120.00	0.50	120.00	80.00	40.00
130	1°18.0′	0°50.70′	65.00	0.16	130.00	0.64	130.00	86.67	43.33
140	1°24.0′	0°58.80′	70.00	0.20	140.00	0.80	140.00	93.33	46.67
150	1°30.0′	1°07.50′	75.00	0.25	149.99	0.98	150.00	100.00	50.00
160	1°36.0′	1°16.80′	80.00	0.30	159.99	1.19	160.00	106.67	53.34
170	1°42.0′	1°26.70′	85.00	0.36	169.99	1.43	170.00	113.34	56.67
180	1°48.0′	1°37.20′	90.00	0.42	179.99	1.70	179.99	120.01	60.00
190	1°54.0′	1°48.30′	95.00	0.50	189.98	2.00	189.99	126.67	63.34
200	2°00.0′	2°00.00′	100.00	0.58	199.98	2.33	199.99	133.34	66.67
210	2°06.0′	2°12.30′	104.99	0.67	209.97	2.69	209.99	140.01	70.01
220	2°12.0′	2°25.20′	109.99	0.77	219.96	3.10	219.98	146.68	73.35
230	2°18.0′	2°38.70′	114.99	0.88	229.95	3.54	229.98	153.35	76.68
240	2°24.0′	2°52.80′	119.99	1.01	239.94	4.02	239.97	160.02	80.02
250	2°30.0′	3°07.50′	124.99	1.14	249.93	4.54	249.97	166.69	83.36
260	2°36.0′	3°22.80′	129.98	1.28	259.91	5.11	259.96	173.36	86.70
270	2°42.0′	3°38.70′	134.98	1.43	269.89	5.72	269.95	180.04	90.03
280	2°48.0′	3°55.20′	139.98	1.60	279.87	6.38	279.94	186.71	93.37
290	2°54.0′	4°12.30′	144.97	1.77	289.84	7.09	289.93	193.39	96.72
300	3°00.0′	4°30.00′	149.97	1.96	299.81	7.85	299.92	200.06	100.06
310	3°06.0′	4°48.30′	154.96	2.17	309.78	8.66	309.90	206.74	103.40
320	3°12.0′	5°07.20′	159.96	2.38	319.74	9.53	319.89	213.42	106.75
330	3°18.0′	5°26.70′	164.95	2.61	329.70	10.45	329.87	220.10	110.09
340	3°24.0′	5°46.80′	169.94	2.86	339.65	11.42	339.85	226.79	113.44
350	3°30.0′	6°07.50′	174.93	3.12	349.60	12.46	349.82	233.47	116.79
360	3°36.0′	6°28.80′	179.92	3.39	359.54	13.56	359.80	240.16	120.15
370	3°42.0′	6°50.70′	184.91	3.68	369.47	14.72	369.77	246.85	123.50
380	3°48.0′	7°13.20′	189.90	3.99	379.40	15.94	379.73	253.54	126.86
390	3°54.0′	7°36.30′	194.89	4.31	389.31	17.23	389.69	260.24	130.22
400	4°00.0′	8°00.00′	199.87	4.65	399.22	18.59	399.65	266.94	133.58
410	4°06.0′	8°24.30′	204.85	5.01	409.12	20.02	409.61	273.64	136.95
420	4°12.0′	8°49.20′	209.83	5.38	419.01	21.51	419.56	280.35	140.32
430	4°18.0′	9°14.70′	214.81	5.78	428.88	23.08	429.50	287.06	143.69
440	4°24.0′	9°40.80′	219.79	6.19	438.75	24.73	439.44	293.77	147.07
450	4°30.0′	10°07.50′	224.77	6.62	448.60	26.45	449.38	300.49	150.45
460	4°36.0′	10°34.80′	229.74	7.07	458.43	28.25	459.30	307.22	153.83
470	4°42.0′	11°02.70′	234.71	7.54	468.26	30.12	469.22	313.95	157.22
480	4°48.0′	11°31.20′	239.68	8.03	478.06	32.08	479.14	320.68	160.62
490	4°54.0′	12°00.30′	244.64	8.54	487.85	34.12	489.04	327.42	164.02
500	5°00.0′	12°30.00′	249.60	9.07	497.63	36.24	498.94	334.17	167.43

THE STANDARD HIGHWAY SPIRAL

a = 1.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	5°06.0′	13°00.30′	254.56	9.63	507.38	38.44	508.83	340.92	170.84
520	5°12.0′	13°31.20′	259.52	10.20	517.11	40.74	518.71	347.68	174.26
530	5°18.0′	14°02.70′	264.47	10.80	526.82	43.12	528.59	354.45	177.68
540	5°24.0′	14°34.80′	269.42	11.42	536.51	45.59	538.45	361.23	181.12
550	5°30.0′	15°07.50′	274.36	12.07	546.18	48.16	548.30	368.01	184.56
560	5°36.0′	15°40.80′	279.30	12.74	555.82	50.81	558.14	374.81	188.01
570	5°42.0′	16°14.70′	284.24	13.43	565.43	53.56	567.97	381.61	191.47
580	5°48.0′	16°49.20′	289.17	14.15	575.02	56.41	577.78	388.43	194.93
590	5°54.0′	17°24.30′	294.09	14.89	584.58	59.35	587.58	395.25	198.41
600	6°00.0′	18°00.00′	299.02	15.65	594.11	62.39	597.37	402.09	201.90
610	6°06.0′	18°36.30′	303.93	16.44	603.60	65.53	607.15	408.94	205.40
620	6°12.0′	19°13.20′	308.84	17.26	613.06	68.77	616.90	415.80	208.91
630	6°18.0′	19°50.70′	313.74	18.11	622.48	72.11	626.65	422.67	212.43
640	6°24.0′	20°28.80′	318.64	18.98	631.87	75.56	636.37	429.56	215.96
650	6°30.0′	21°07.50′	323.53	19.87	641.22	79.11	646.08	436.46	219.51
660	6°36.0′	21°46.80′	328.42	20.80	650.53	82.77	655.77	443.38	223.07
670	6°42.0′	22°26.70′	333.29	21.75	659.79	86.53	665.44	450.31	226.65
680	6°48.0′	23°07.20′	338.16	22.73	669.01	90.41	675.09	457.26	230.24
690	6°54.0′	23°48.30′	343.02	23.74	678.18	94.39	684.72	464.23	233.85
700	7°00.0′	24°30.00′	347.88	24.78	687.31	98.48	694.33	471.22	237.47
710	7°06.0′	25°12.30′	352.72	25.85	696.38	102.68	703.91	478.22	241.12
720	7°12.0′	25°55.20′	357.56	26.95	705.40	107.00	713.47	485.25	244.78
730	7°18.0′	26°38.70′	362.38	28.07	714.37	111.42	723.01	492.30	248.46
740	7°24.0′	27°22.80′	367.20	29.23	723.28	115.97	732.52	499.37	252.16
750	7°30.0′	28°07.50′	372.01	30.42	732.13	120.62	742.00	506.46	255.88
760	7°36.0′	28°52.80′	376.80	31.64	740.92	125.39	751.45	513.58	259.63
770	7°42.0′	29°38.70′	381.59	32.88	749.64	130.28	760.88	520.72	263.40
780	7°48.0′	30°25.20′	386.36	34.17	758.30	135.29	770.27	527.89	267.19
790	7°54.0′	31°12.30′	391.13	35.48	766.89	140.41	779.63	535.09	271.01
800	8°00.0′	32°00.00′	395.88	36.82	775.40	145.65	788.96	542.32	274.85
810	8°06.0′	32°48.30′	400.61	38.20	783.85	151.01	798.26	549.57	278.72
820	8°12.0′	33°37.20′	405.34	39.61	792.21	156.48	807.52	556.86	282.63
830	8°18.0′	34°26.70′	410.05	41.05	800.50	162.08	816.74	564.18	286.56
840	8°24.0′	35°16.80′	414.75	42.52	808.71	167.80	825.93	571.54	290.52
850	8°30.0′	36°07.50′	419.43	44.03	816.83	173.63	835.08	578.93	294.52
860	8°36.0′	36°58.80′	424.10	45.57	824.86	179.59	844.18	586.36	298.55
870	8°42.0′	37°50.70′	428.75	47.15	832.80	185.66	853.25	593.83	302.62
880	8°48.0′	38°43.20′	433.39	48.76	840.65	191.86	862.27	601.34	306.72
890	8°54.0′	39°36.30′	438.01	50.40	848.41	198.17	871.24	608.90	310.87
900	9°00.0′	40°30.00′	442.61	52.08	856.06	204.61	880.17	616.49	315.05
910	9°06.0′	41°24.30′	447.19	53.79	863.61	211.16	889.05	624.14	319.28
920	9°12.0′	42°19.20′	451.76	55.54	871.06	217.84	897.89	631.83	323.55
930	9°18.0′	43°14.70′	456.31	57.32	878.40	224.63	906.67	639.57	327.87
940	9°24.0′	44°10.80′	460.84	59.14	885.63	231.54	915.39	647.37	332.23
950	9°30.0′	45°07.50′	465.35	60.99	892.74	238.57	924.07	655.21	336.65
960	9°36.0′	46°04.80′	469.83	62.87	899.74	245.71	932.69	663.12	341.12
970	9°42.0′	47°02.70′	474.30	64.80	906.61	252.97	941.25	671.08	345.64
980	9°48.0′	48°01.20′	478.75	66.75	913.37	260.35	949.75	679.11	350.22
990	9°54.0′	49°00.30′	483.17	68.75	919.99	267.84	958.19	687.20	354.86
1000	10°00.0′	50°00.00′	487.57	70.78	926.48	275.44	966.56	695.36	359.57

THE STANDARD HIGHWAY SPIRAL

$a = 1.25$

L	D	S	q	p	Y	X	C	U	V
10	0°07.5′	0°00.38′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°15.0′	0°01.50′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°22.5′	0°03.38′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°30.0′	0°06.00′	20.00	0.01	40.00	0.02	40.00	26.67	13.33
50	0°37.5′	0°09.38′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0°45.0′	0°13.50′	30.00	0.02	60.00	0.08	60.00	40.00	20.00
70	0°52.5′	0°18.38′	35.00	0.03	70.00	0.12	70.00	46.67	23.33
80	1°00.0′	0°24.00′	40.00	0.05	80.00	0.19	80.00	53.33	26.67
90	1°07.5′	0°30.38′	45.00	0.07	90.00	0.27	90.00	60.00	30.00
100	1°15.0′	0°37.50′	50.00	0.09	100.00	0.36	100.00	66.67	33.33
110	1°22.5′	0°45.38′	55.00	0.12	110.00	0.48	110.00	73.33	36.67
120	1°30.0′	0°54.00′	60.00	0.16	120.00	0.63	120.00	80.00	40.00
130	1°37.5′	1°03.38′	65.00	0.20	130.00	0.80	130.00	86.67	43.33
140	1°45.0′	1°13.50′	70.00	0.25	139.99	1.00	140.00	93.34	46.67
150	1°52.5′	1°24.38′	75.00	0.31	149.99	1.23	150.00	100.00	50.00
160	2°00.0′	1°36.00′	80.00	0.37	159.99	1.49	159.99	106.67	53.34
170	2°07.5′	1°48.38′	85.00	0.45	169.98	1.79	169.99	113.34	56.67
180	2°15.0′	2°01.50′	90.00	0.53	179.98	2.12	179.99	120.01	60.01
190	2°22.5′	2°15.38′	95.00	0.62	189.97	2.49	189.99	126.68	63.34
200	2°30.0′	2°30.00′	99.99	0.73	199.96	2.91	199.98	133.35	66.68
210	2°37.5′	2°45.38′	104.99	0.84	209.95	3.37	209.98	140.02	70.02
220	2°45.0′	3°01.50′	109.99	0.97	219.94	3.87	219.97	146.69	73.35
230	2°52.5′	3°18.38′	114.99	1.11	229.92	4.42	229.97	153.36	76.69
240	3°00.0′	3°36.00′	119.98	1.26	239.91	5.03	239.96	160.03	80.03
250	3°07.5′	3°54.38′	124.98	1.42	249.88	5.68	249.95	166.71	83.37
260	3°15.0′	4°13.50′	129.98	1.60	259.86	6.39	259.94	173.38	86.71
270	3°22.5′	4°33.38′	134.97	1.79	269.83	7.15	269.92	180.06	90.05
280	3°30.0′	4°54.00′	139.97	1.99	279.80	7.98	279.91	186.74	93.40
290	3°37.5′	5°15.38′	144.96	2.22	289.76	8.86	289.89	193.42	96.74
300	3°45.0′	5°37.50′	149.95	2.45	299.71	9.81	299.87	200.10	100.09
310	3°52.5′	6°00.38′	154.94	2.71	309.66	10.82	309.85	206.79	103.44
320	4°00.0′	6°24.00′	159.93	2.98	319.60	11.90	319.82	213.47	106.79
330	4°07.5′	6°48.38′	164.92	3.27	329.53	13.05	329.79	220.16	110.15
340	4°15.0′	7°13.50′	169.91	3.57	339.46	14.28	339.76	226.86	113.51
350	4°22.5′	7°39.38′	174.90	3.89	349.38	15.57	349.72	233.55	116.87
360	4°30.0′	8°06.00′	179.88	4.24	359.28	16.94	359.68	240.25	120.23
370	4°37.5′	8°33.38′	184.86	4.60	369.18	18.39	369.63	246.96	123.60
380	4°45.0′	9°01.50′	189.84	4.98	379.06	19.92	379.58	253.66	126.97
390	4°52.5′	9°30.38′	194.82	5.39	388.93	21.53	389.52	260.38	130.34
400	5°00.0′	10°00.00′	199.80	5.81	398.78	23.22	399.46	267.09	133.72
410	5°07.5′	10°30.38′	204.77	6.26	408.62	25.00	409.39	273.82	137.11
420	5°15.0′	11°01.50′	209.74	6.73	418.45	26.87	419.31	280.54	140.50
430	5°22.5′	11°33.38′	214.71	7.22	428.25	28.83	429.22	287.28	143.89
440	5°30.0′	12°06.00′	219.67	7.73	438.04	30.88	439.13	294.02	147.29
450	5°37.5′	12°39.38′	224.63	8.27	447.81	33.02	449.02	300.77	150.70
460	5°45.0′	13°13.50′	229.59	8.83	457.56	35.26	458.91	307.53	154.12
470	5°52.5′	13°48.38′	234.55	9.42	467.28	37.59	468.79	314.29	157.54
480	6°00.0′	14°24.00′	239.50	10.03	476.98	40.03	478.65	321.07	160.97
490	6°07.5′	15°00.38′	244.44	10.67	486.65	42.57	488.51	327.85	164.41
500	6°15.0′	15°37.50′	249.38	11.33	496.29	45.21	498.35	334.64	167.86

THE STANDARD HIGHWAY SPIRAL

a = 1.25—Continued

L	D	S	q	p	Y	X	C	U	V
510	6°22.5′	16°15.38′	254.32	12.02	505.91	47.96	508.18	341.44	171.31
520	6°30.0′	16°54.00′	259.25	12.74	515.49	50.81	517.99	348.26	174.78
530	6°37.5′	17°33.38′	264.17	13.49	525.05	53.77	527.79	355.09	178.26
540	6°45.0′	18°13.50′	269.09	14.26	534.56	56.84	537.58	361.93	181.75
550	6°52.5′	18°54.38′	274.00	15.07	544.04	60.03	547.34	368.78	185.26
560	7°00.0′	19°36.00′	278.91	15.90	553.48	63.32	557.09	375.65	188.77
570	7°07.5′	20°18.38′	283.81	16.76	562.88	66.74	566.82	382.53	192.30
580	7°15.0′	21°01.50′	288.70	17.65	572.24	70.27	576.54	389.43	195.85
590	7°22.5′	21°45.38′	293.59	18.57	581.55	73.91	586.23	396.35	199.41
600	7°30.0′	22°30.00′	298.46	19.53	590.81	77.68	595.90	403.28	202.98
610	7°37.5′	23°15.38′	303.33	20.51	600.03	81.57	605.55	410.23	206.58
620	7°45.0′	24°01.50′	308.19	21.53	609.19	85.58	615.17	417.21	210.19
630	7°52.5′	24°48.38′	313.04	22.58	618.29	89.71	624.77	424.20	213.82
640	8°00.0′	25°36.00′	317.88	23.66	627.34	93.97	634.34	431.22	217.47
650	8°07.5′	26°24.38′	322.71	24.78	636.33	98.35	643.88	438.25	221.15
660	8°15.0′	27°13.50′	327.53	25.92	645.25	102.86	653.40	445.32	224.84
670	8°22.5′	28°03.38′	332.34	27.11	654.11	107.50	662.89	452.41	228.56
680	8°30.0′	28°54.00′	337.14	28.32	662.90	112.27	672.34	459.53	232.31
690	8°37.5′	29°45.38′	341.92	29.58	671.62	117.17	681.76	466.67	236.08
700	8°45.0′	30°37.50′	346.69	30.86	680.26	122.20	691.15	473.85	239.87
710	8°52.5′	31°30.38′	351.45	32.19	688.83	127.36	700.50	481.05	243.70
720	9°00.0′	32°24.00′	356.20	33.54	697.31	132.65	709.82	488.29	247.56
730	9°07.5′	33°18.38′	360.93	34.94	705.72	138.07	719.10	495.57	251.45
740	9°15.0′	34°13.50′	365.64	36.37	714.03	143.63	728.33	502.88	255.37
750	9°22.5′	35°09.38′	370.34	37.84	722.25	149.32	737.53	510.23	259.33
760	9°30.0′	36°06.00′	375.03	39.34	730.38	155.15	746.68	517.62	263.32
770	9°37.5′	37°03.38′	379.69	40.89	738.41	161.11	755.78	525.05	267.35
780	9°45.0′	38°01.50′	384.34	42.47	746.34	167.20	764.84	532.53	271.42
790	9°52.5′	39°00.38′	388.98	44.08	754.16	173.43	773.85	540.05	275.54
800	10°00.0′	40°00.00′	393.59	45.74	761.88	179.79	782.80	547.62	279.70
810	10°07.5′	41°00.38′	398.18	47.44	769.48	186.28	791.71	555.24	283.90
820	10°15.0′	42°01.50′	402.76	49.17	776.97	192.91	800.56	562.91	288.16
830	10°22.5′	43°03.38′	407.31	50.94	784.34	199.67	809.35	570.64	292.46
840	10°30.0′	44°06.00′	411.84	52.75	791.58	206.56	818.09	578.43	296.82
850	10°37.5′	45°09.38′	416.35	54.60	798.70	213.59	826.77	586.27	301.24
860	10°45.0′	46°13.50′	420.84	56.49	805.68	220.74	835.38	594.18	305.71
870	10°52.5′	47°18.38′	425.30	58.42	812.53	228.03	843.93	602.16	310.25
880	11°00.0′	48°24.00′	429.74	60.39	819.25	235.44	852.41	610.21	314.85
890	11°07.5′	49°30.38′	434.15	62.40	825.81	242.98	860.82	618.33	319.52
900	11°15.0′	50°37.50′	438.54	64.45	832.23	250.65	869.16	626.53	324.25
910	11°22.5′	51°45.38′	442.90	66.54	838.50	258.44	877.42	634.80	329.07
920	11°30.0′	52°54.00′	447.23	68.67	844.61	266.36	885.61	643.16	333.96
930	11°37.5′	54°03.38′	451.54	70.84	850.56	274.40	893.73	651.61	338.93
940	11°45.0′	55°13.50′	455.82	73.05	856.35	282.55	901.76	660.15	343.99
950	11°52.5′	56°24.38′	460.06	75.29	861.97	290.82	909.71	668.79	349.13
960	12°00.0′	57°36.00′	464.28	77.58	867.41	299.21	917.57	677.53	354.38
970	12°07.5′	58°48.38′	468.46	79.91	872.68	307.71	925.34	686.37	359.72
980	12°15.0′	60°01.50′	472.61	82.28	877.77	316.32	933.03	695.33	365.16
990	12°22.5′	61°15.38′	476.73	84.69	882.67	325.03	940.62	704.40	370.71
1000	12°30.0′	62°30.00′	480.81	87.14	887.39	333.85	948.11	713.59	376.38

THE STANDARD HIGHWAY SPIRAL

$a = 1\frac{1}{3}$

L	D	S	q	p	Y	X	C	U	V
10	0°08.0′	0°00.40′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°16.0′	0°01.60′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°24.0′	0°03.60′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°32.0′	0°06.40′	20.00	0.01	40.00	0.02	40.00	26.67	13.33
50	0°40.0′	0°10.00′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0°48.0′	0°14.40′	30.00	0.02	60.00	0.08	60.00	40.00	20.00
70	0°56.0′	0°19.60′	35.00	0.03	70.00	0.13	70.00	46.67	23.33
80	1°04.0′	0°25.60′	40.00	0.05	80.00	0.20	80.00	53.33	26.67
90	1°12.0′	0°32.40′	45.00	0.07	90.00	0.28	90.00	60.00	30.00
100	1°20.0′	0°40.00′	50.00	0.10	100.00	0.39	100.00	66.67	33.33
110	1°28.0′	0°48.40′	55.00	0.13	110.00	0.52	110.00	73.33	36.67
120	1°36.0′	0°57.60′	60.00	0.17	120.00	0.67	120.00	80.00	40.00
130	1°44.0′	1°07.60′	65.00	0.21	129.99	0.85	130.00	86.67	43.33
140	1°52.0′	1°18.40′	70.00	0.27	139.99	1.06	140.00	93.34	46.67
150	1°60.0′	1°30.00′	75.00	0.33	149.99	1.31	150.00	100.00	50.00
160	2°08.0′	1°42.40′	80.00	0.40	159.99	1.59	159.99	106.67	53.34
170	2°16.0′	1°55.60′	85.00	0.48	169.98	1.91	169.99	113.34	56.67
180	2°24.0′	2°09.60′	90.00	0.57	179.97	2.26	179.99	120.01	60.01
190	2°32.0′	2°24.40′	94.99	0.67	189.97	2.66	189.99	126.68	63.34
200	2°40.0′	2°40.00′	99.99	0.78	199.96	3.10	199.98	133.35	66.68
210	2°48.0′	2°56.40′	104.99	0.90	209.94	3.59	209.98	140.02	70.02
220	2°56.0′	3°13.60′	109.99	1.03	219.93	4.13	219.97	146.69	73.36
230	3°04.0′	3°31.60′	114.99	1.18	229.91	4.72	229.96	153.36	76.69
240	3°12.0′	3°50.40′	119.98	1.34	239.89	5.36	239.95	160.04	80.03
250	3°20.0′	4°10.00′	124.98	1.51	249.87	6.06	249.94	166.71	83.38
260	3°28.0′	4°30.40′	129.97	1.70	259.84	6.81	259.93	173.39	86.72
270	3°36.0′	4°51.60′	134.97	1.91	269.81	7.63	269.91	180.07	90.06
280	3°44.0′	5°13.60′	139.96	2.13	279.77	8.51	279.90	186.75	93.41
290	3°52.0′	5°36.40′	144.95	2.36	289.72	9.45	289.88	193.43	96.75
300	3°60.0′	5°60.00′	149.95	2.62	299.67	10.46	299.85	200.12	100.10
310	4°08.0′	6°24.40′	154.94	2.89	309.61	11.54	309.83	206.80	103.46
320	4°16.0′	6°49.60′	159.92	3.18	319.55	12.70	319.80	213.49	106.81
330	4°24.0′	7°15.60′	164.91	3.48	329.47	13.92	329.76	220.19	110.17
340	4°32.0′	7°42.40′	169.90	3.81	339.39	15.22	339.73	226.88	113.53
350	4°40.0′	8°10.00′	174.88	4.15	349.29	16.60	349.68	233.58	116.89
360	4°48.0′	8°38.40′	179.86	4.52	359.18	18.07	359.64	240.29	120.26
370	4°56.0′	9°07.60′	184.84	4.91	369.06	19.61	369.58	247.00	123.63
380	5°04.0′	9°37.60′	189.82	5.32	378.93	21.24	379.52	253.71	127.01
390	5°12.0′	10°08.40′	194.80	5.75	388.78	22.96	389.46	260.43	130.39
400	5°20.0′	10°40.00′	199.77	6.20	398.62	24.76	399.38	267.15	133.78
410	5°28.0′	11°12.40′	204.74	6.67	408.43	26.66	409.30	273.88	137.17
420	5°36.0′	11°45.60′	209.71	7.17	418.23	28.65	419.21	280.62	140.56
430	5°44.0′	12°19.60′	214.67	7.70	428.01	30.73	429.12	287.36	143.97
440	5°22.0′	12°54.40′	219.63	8.24	437.77	32.92	439.01	294.12	147.38
450	5°60.0′	13°30.00′	224.58	8.82	447.51	35.20	448.89	300.88	150.80
460	6°08.0′	14°06.40′	229.54	9.42	457.22	37.59	458.76	307.65	154.22
470	6°16.0′	14°43.60′	234.48	10.04	466.90	40.08	468.62	314.42	157.66
480	6°24.0′	15°21.60′	239.43	10.70	476.56	42.67	478.47	321.21	161.10
490	6°32.0′	16°00.40′	244.36	11.38	486.19	45.38	488.30	328.01	164.56
500	6°40.0′	16°40.00′	249.30	12.08	495.79	48.19	498.12	334.82	168.02

THE STANDARD HIGHWAY SPIRAL

a = 1⅓—Continued

L	D	S	q	p	Y	X	C	U	V
510	6°48.0′	17°20.40′	254.22	12.82	505.35	51.11	507.93	341.65	171.50
520	6°56.0′	18°01.60′	259.14	13.59	514.88	54.15	517.72	348.48	174.98
530	7°04.0′	18°43.60′	264.06	14.38	524.37	57.30	527.49	355.33	178.48
540	7°12.0′	19°26.40′	268.97	15.21	533.82	60.57	537.24	362.20	182.00
550	7°20.0′	20°10.00′	273.87	16.06	543.23	63.96	546.98	369.07	185.52
560	7°28.0′	20°54.40′	278.76	16.95	552.59	67.47	556.69	375.97	189.07
570	7°36.0′	21°39.60′	283.65	17.87	561.91	71.10	566.39	382.88	192.62
580	7°44.0′	22°25.60′	288.53	18.82	571.18	74.85	576.06	389.82	196.20
590	7°52.0′	23°12.40′	293.39	19.80	580.39	78.73	585.71	396.77	199.79
600	7°60.0′	23°60.00′	298.25	20.81	589.56	82.73	595.33	403.74	203.40
610	8°08.0′	24°48.40′	303.10	21.86	598.66	86.86	604.93	410.73	207.03
620	8°16.0′	25°37.60′	307.94	22.94	607.71	91.12	614.51	417.75	210.69
630	8°24.0′	26°27.60′	312.77	24.06	616.70	95.51	624.05	424.79	214.36
640	8°32.0′	27°18.40′	317.59	25.21	625.62	100.03	633.56	431.86	218.06
650	8°40.0′	28°10.00′	322.40	26.40	634.47	104.69	643.05	438.95	221.78
660	8°48.0′	29°02.40′	327.19	27.62	643.25	109.48	652.50	446.07	225.53
670	8°56.0′	29°55.60′	331.98	28.88	651.95	114.40	661.91	453.22	229.30
680	9°04.0′	30°49.60′	336.75	30.17	660.58	119.45	671.29	460.40	233.11
690	9°12.0′	31°44.40′	341.50	31.51	669.12	124.65	680.63	467.62	236.94
700	9°20.0′	32°40.00′	346.24	32.87	677.59	129.98	689.94	474.87	240.81
710	9°28.0′	33°36.39′	350.97	34.28	685.96	135.44	699.20	482.15	244.71
720	9°36.0′	34°33.59′	355.68	35.72	694.24	141.05	708.42	489.48	248.64
730	9°44.0′	35°31.59′	360.37	37.21	702.43	146.79	717.60	496.84	252.61
740	9°52.0′	36°30.39′	365.05	38.73	710.52	152.67	726.73	504.25	256.62
750	9°60.0′	37°29.99′	369.71	40.29	718.50	158.69	735.82	511.70	260.67
760	10°08.0′	38°30.39′	374.35	41.88	726.38	164.84	744.85	519.20	264.76
770	10°16.0′	39°31.59′	378.97	43.52	734.15	171.14	753.84	526.74	268.90
780	10°24 0′	40°33.59′	383.58	45.20	741.81	177.57	762.77	534.34	273.08
790	10°32.0′	41°36.39′	388.16	46.92	749.35	184.14	771.64	541.99	277.32
800	10°40.0′	42°39.99′	392.72	48.67	756.76	190.85	780.46	549.70	281.60
810	10°48.0′	43°44.39′	397.26	50.47	764.05	197.70	789.21	557.46	285.94
820	10°56.0′	44°49.59′	401.78	52.31	771.21	204.68	797.91	565.29	290.34
830	11°04.0′	45°55.59′	406.27	54.19	778.23	211.80	806.54	573.18	294.80
840	11°12.0′	47°02.39′	410.74	56.11	785.12	219.05	815.10	581.14	299.31
850	11°20.0′	48°09.99′	415.18	58.07	791.86	226.43	823.60	589.17	303.90
860	11°28 0′	49°18.39′	419.60	60.07	798.46	233.95	832.03	597.28	308.55
870	11°36.0′	50°27.59′	423.99	62.11	804.90	241.60	840.38	605.46	313.28
880	11°44.0′	51°37.59′	428.36	64.19	811.19	249.37	848.65	613.73	318.08
890	11°52.0′	52°48.39′	432.69	66.32	817.32	257.27	856.85	622.08	322.97
900	11°60.0′	53°59.99′	437.00	68.48	823.28	265.30	864.97	630.52	327.93
910	12°08.0′	55°12.39′	441.28	70.69	829.07	273.45	873.00	639.06	332.99
920	12°16.0′	56°25.59′	445.52	72.94	834.69	281.73	880.95	647.70	338.13
930	12°24.0′	57°39.59′	449.74	75.23	840.13	290.12	888.81	656.44	343.38
940	12°32.0′	58°54.39′	453.92	77.56	845.39	298.62	896.58	665.29	348.73
950	12°40.0′	60°09.99′	458.07	79.93	850.46	307.24	904.25	674.26	354.18
960	12°48.0′	61°26.39′	462.18	82.35	855.33	315.97	911.83	683.35	359.75
970	12°56.0′	62°43.59′	466.26	84.80	860.02	324.81	919.31	692.56	365.43
980	13°04.0′	64°01.59′	470.30	87.30	864.50	333.75	926.68	701.91	371.24
990	13°12.0′	65°20.39′	474.30	89.83	868.77	342.79	933.95	711.40	377.19
1000	13°20.0′	66°39.99′	478.27	92.41	872.84	351.92	941.12	721.04	383.27

THE STANDARD HIGHWAY SPIRAL

a = 1.5

L	D	S	q	p	Y	X	C	U	V
10	0°09.0′	0°00.45′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°18.0′	0°01.80′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°27.0′	0°04.05′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°36.0′	0°07.20′	20.00	0.01	40.00	0.03	40.00	26.67	13.33
50	0°45.0′	0°11.25′	25.00	0.01	50.00	0.05	50.00	33.33	16.67
60	0°54.0′	0°16.20′	30.00	0.02	60.00	0.09	60.00	40.00	20.00
70	1°03.0′	0°22.05′	35.00	0.04	70.00	0.15	70.00	46.67	23.33
80	1°12.0′	0°28.80′	40.00	0.06	80.00	0.22	80.00	53.33	26.67
90	1°21.0′	0°36.45′	45.00	0.08	90.00	0.32	90.00	60.00	30.00
100	1°30.0′	0°45.00′	50.00	0.11	100.00	0.44	100.00	66.67	33.33
110	1°39.0′	0°54.45′	55.00	0.15	110.00	0.58	110.00	73.33	36.67
120	1°48.0′	1°04.80′	60.00	0.19	120.00	0.75	120.00	80.00	40.00
130	1°57.0′	1°16.05′	65.00	0.24	129.99	0.96	130.00	86.67	43.34
140	2°06.0′	1°28.20′	70.00	0.30	139.99	1.20	140.00	93.34	46.67
150	2°15.0′	1°41.25′	75.00	0.37	149.99	1.47	149.99	100.00	50.00
160	2°24.0′	1°55.20′	80.00	0.45	159.98	1.79	159.99	106.67	43.34
170	2°33.0′	2°10.05′	85.00	0.54	169.98	2.14	169.99	113.34	56.67
180	2°42.0′	2°25.80′	89.99	0.64	179.97	2.54	179.99	120.01	60.01
190	2°51.0′	2°42.45′	94.99	0.75	189.96	2.99	189.98	126.68	63.35
200	3°00.0′	3°00.00′	99.99	0.87	199.95	3.49	199.98	133.35	66.68
210	3°09.0′	3°18.45′	104.99	1.01	209.93	4.04	209.97	140.02	70.02
220	3°18.0′	3°37.80′	109.99	1.16	219.91	4.64	219.96	146.70	73.36
230	3°27.0′	3°58.05′	114.98	1.33	229.89	5.31	229.95	153.37	76.70
240	3°36.0′	4°19.20′	119.98	1.51	239.86	6.03	239.94	160.05	80.04
250	3°45.0′	4°41.25′	124.97	1.70	249.83	6.81	249.93	166.73	83.39
260	3°54.0′	5°04.20′	129.97	1.92	259.80	7.66	259.91	173.40	86.73
270	4°03.0′	5°28.05′	134.96	2.15	269.75	8.58	269.89	180.09	90.08
280	4°12.0′	5°52.80′	139.95	2.39	279.71	9.57	279.87	186.77	93.43
290	4°21.0′	6°18.45′	144.94	2.66	289.65	10.63	289.84	193.46	96.78
300	4°30.0′	6°45.00′	149.93	2.94	299.58	11.77	299.81	200.15	100.13
310	4°39.0′	7°12.45′	154.92	3.25	309.51	12.98	309.78	206.84	103.49
320	4°48.0′	7°40.80′	159.90	3.57	319.43	14.28	319.74	213.53	106.85
330	4°57.0′	8°10.05′	164.89	3.92	329.33	15.66	329.70	220.23	110.21
340	5°06.0′	8°40.20′	169.87	4.28	339.22	17.12	339.65	226.94	113.58
350	5°15.0′	9°11.25′	174.85	4.67	349.10	18.67	349.60	233.65	116.95
360	5°24.0′	9°43.20′	179.83	5.08	358.97	20.32	359.54	240.36	120.33
370	5°33.0′	10°16.05′	184.80	5.52	368.81	22.05	369.47	247.08	123.71
380	5°42.0′	10°49.80′	189.77	5.98	378.64	23.88	379.40	253.81	127.10
390	5°51.0′	11°24.45′	194.74	6.46	388.46	25.81	389.31	260.54	130.49
400	6°00.0′	12°00.00′	199.71	6.97	398.25	27.84	399.22	267.28	133.89
410	6°09.0′	12°36.45′	204.67	7.51	408.02	29.97	409.12	274.03	137.30
420	6°18.0′	13°13.80′	209.63	8.07	417.77	32.20	419.01	280.79	140.71
430	6°27.0′	13°52.05′	214.58	8.65	427.49	34.55	428.88	287.55	144.14
440	6°36.0′	14°31.20′	219.53	9.27	437.18	37.00	438.75	294.33	147.57
450	6°45.0′	15°11.25′	224.47	9.92	446.85	39.56	448.60	301.11	151.01
460	6°54.0′	15°52.20′	229.41	10.59	456.48	42.24	458.43	307.91	154.46
470	7°03.0′	16°34.05′	234.35	11.29	466.09	45.03	468.26	314.72	157.93
480	7°12.0′	17°16.80′	239.27	12.02	475.65	47.94	478.06	321.54	161.40
490	7°21.0′	18°00.45′	244.20	12.79	485.18	50.97	487.85	328.37	164.89
500	7°30.0′	18°45.00′	249.11	13.58	494.67	54.13	497.62	335.22	168.39

THE STANDARD HIGHWAY SPIRAL

a = 1.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	7°39.0′	19°30.45′	254.02	14.41	504.12	57.40	507.38	342.09	171.90
520	7°48.0′	20°16.80′	258.92	15.27	513.52	60.80	517.11	348.97	175.43
530	7°57.0′	21°04.05′	263.81	16.16	522.88	64.34	526.82	355.87	178.97
540	8°06.0′	21°52.20′	268.69	17.09	532.19	67.99	536.51	362.79	182.54
550	8°15.0′	22°41.25′	273.57	18.05	541.44	71.79	546.18	369.72	186.12
560	8°24.0′	23°31.20′	278.43	19.04	550.64	75.71	555.82	376.68	189.72
570	8°33.0′	24°22.05′	283.29	20.07	559.78	79.77	565.43	383.66	193.34
580	8°42.0′	25°13.80′	288.14	21.14	568.85	83.96	575.02	390.67	196,98
590	8°51.0′	26°06.45′	292.97	22.24	577.87	88.29	584.57	397.70	200.64
600	9°00.0′	27°00.00′	297.79	23.38	586.81	92.76	594.10	404.75	204.33
610	9°09.0′	27°54.45′	302.60	24.55	595.69	97.37	603.59	411.84	208.04
620	9°18.0′	28°49.80′	307.40	25.76	604.49	102.12	613.05	418.95	211.78
630	9°27.0′	29°46.05′	312.19	27.01	613.21	107.02	622.47	426.10	215.55
640	9°36.0′	30°43.20′	316.96	28.30	621.84	112.05	631.86	433.27	219.35
650	9°45.0′	31°41.25′	321.71	29.63	630.40	117.24	641.21	440.49	223.18
660	9°54.0′	32°40.20′	326.46	31.00	638.86	122.56	650.51	447.73	227.05
670	10°03.0′	33°40.05′	331.18	32.41	647.23	128.03	659.77	455.02	230.95
680	10°12.0′	34°40.80′	335.89	33.85	655.51	133.65	668.99	462.35	234.89
690	10°21.0′	35°42.45′	340.58	35.34	663.68	139.41	678.16	469.72	238.86
700	10°30.0′	36°45.00′	345.25	36.87	671.74	145.32	687.28	477.14	242.88
710	10°39.0′	37°48.45′	349.91	38.44	679.70	151.38	696.35	484.60	246.94
720	10°48.0′	38°52.80′	354.54	40.05	687.55	157.58	705.37	492.11	251.05
730	10°57.0′	39°58.05′	359.16	41.71	695.27	163.93	714.33	499.68	255.20
740	11°06.0′	41°04.20′	363.76	43.40	702.87	170.43	723.24	507.30	259.41
750	11°15.0′	42°11.25′	368.32	45.14	710.35	177.07	732.08	514.98	263.67
760	11°24.0′	43°19.20′	372.87	46.92	717.69	183.86	740.87	522.72	267.99
770	11°33.0′	44°28.05′	377.40	48.74	724.90	190.79	749.58	530.52	272.36
780	11°42.0′	45°37.80′	381.90	50.61	731.96	197.87	758.23	538.40	276.80
790	11°51.0′	46°48.45′	386.37	52.52	738.88	205.09	766.81	546.34	281.31
800	12°00.0′	48°00.00′	390.82	54.47	745.65	212.45	775.32	554.36	285.88
810	12°09.0′	49°12.45′	395.24	56.47	752.26	219.95	783.76	562.45	290.53
820	12°18.0′	50°25.80′	399.64	58.51	758.71	227.59	792.11	570.63	295.25
830	12°27.0′	51°40.05′	404.00	60.59	765.00	235.37	800.39	578.90	300.05
840	12°36.0′	52°55.20′	408.34	62.72	771.12	243.28	808.58	587.26	304.94
850	12°45.0′	54°11.25′	412.64	64.89	777.06	251.32	816.69	595.71	309.92
860	12°54.0′	55°28.20′	416.91	67.11	782.82	259.50	824.71	604.27	314.99
870	13°03.0′	56°46.05′	421.15	69.36	788.39	267.80	832.63	612.93	320.16
880	13°12.0′	58°04.80′	425.35	71.67	793.78	276.22	840.46	621.71	325.43
890	13°21.0′	59°24.45′	429.52	74.01	798.96	284.77	848.20	630.60	330.82
900	13°30.0′	60°45.00′	433.65	76.40	803.95	293.44	855.83	639.62	336.32
910	13°39.0′	62°06.45′	437.75	78.84	808.74	302.22	863.36	648.77	341.95
920	13°48.0′	63°28.80′	441.81	81.31	813.31	311.11	870.78	658.06	347.70
930	13°57.0′	64°52.05′	445.83	83.83	817.66	320.12	878.09	667.49	353.59
940	14°06.0′	66°16.20′	449.80	86.39	821.80	329.22	885.29	677.08	359.63
950	14°15.0′	67°41.25′	453.74	89.00	825.71	338.42	892.37	686.83	365.81
960	14°24.0′	69°07.20′	457.63	91.65	829.39	347.72	899.33	696.75	372.16
970	14°33.0′	70°34.05′	461.48	94.33	832.84	357.11	906.17	706.85	378.68
980	14°42.0′	72°01.80′	465.29	97.06	836.04	366.58	912.88	717.15	385.38
990	14°51.0′	73°30.45′	469.05	99.83	839.01	376.13	919.46	727.64	392.27
1000	15°00.0′	75°00.00′	472.76	102.64	841.72	385.76	925.90	738.36	399.36

THE STANDARD HIGHWAY SPIRAL

a = 1.75

L	D	S	q	p	Y	X	C	U	V
10	0°10.5′	0°00.53′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°21.0′	0°02.10′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°31.5′	0°04.73′	15.00	0.00	30.00	0.01	30.00	20.00	10.00
40	0°42.0′	0°08.40′	20.00	0.01	40.00	0.03	40.00	26.67	13.33
50	0°52.5′	0°13.13′	25.00	0.02	50.00	0.06	50.00	33.33	16.67
60	1°03.0′	0°18.90′	30.00	0.03	60.00	0.11	60.00	40.00	20.00
70	1°13.5′	0°25.73′	35.00	0.04	70.00	0.17	70.00	46.67	23.33
80	1°24.0′	0°33.60′	40.00	0.07	80.00	0.26	80.00	53.33	26.67
90	1°34.5′	0°42.53′	45.00	0.09	90.00	0.37	90.00	60.00	30.00
100	1°45.0′	0°52.50′	50.00	0.13	100.00	0.51	100.00	66.67	33.33
110	1°55.5′	1°03.53′	55.00	0.17	110.00	0.68	110.00	73.33	36.67
120	2°06.0′	1°15.60′	60.00	0.22	119.99	0.88	120.00	80.00	40.00
130	2°16.5′	1°28.73′	65.00	0.28	129.99	1.12	130.00	86.67	43.34
140	2°27.0′	1°42.90′	70.00	0.35	139.99	1.40	139.99	93.34	46.67
150	2°37.5′	1°58.13′	75.00	0.43	149.98	1.72	149.99	100.01	50.01
160	2°48.0′	2°14.40′	80.00	0.52	159.98	2.08	159.99	106.68	53.34
170	2°58.5′	2°31.73′	84.99	0.63	169.97	2.50	169.99	113.34	56.68
180	3°09.0′	2°50.10′	89.99	0.74	179.96	2.97	179.98	120.02	60.01
190	3°19.5′	3°09.53′	94.99	0.87	189.94	3.49	189.97	126.69	63.35
200	3°30.0′	3°30.00′	99.99	1.01	199.93	4.07	199.97	133.36	66.69
210	3°40.5′	3°51.53′	104.98	1.18	209.90	4.71	209.96	140.03	70.03
220	3°51.0′	4°14.10′	109.98	1.35	219.88	5.42	219.95	146.71	73.37
230	4°01.5′	4°37.73′	114.97	1.55	229.85	6.19	229.93	153.39	76.71
240	4°12.0′	5°02.40′	119.97	1.76	239.81	7.03	239.92	160.06	80.06
250	4°22.5′	5°28.13′	124.96	1.99	249.77	7.95	249.90	166.75	83.41
260	4°33.0′	5°54.90′	129.95	2.24	259.72	8.94	259.88	173.43	86.75
270	4°43.5′	6°22.73′	134.94	2.50	269.67	10.01	269.85	180.12	90.11
280	4°54.0′	6°51.60′	139.93	2.79	279.60	11.16	279.82	186.81	93.46
290	5°04.5′	7°21.53′	144.92	3.10	289.52	12.40	289.79	193.50	96.82
300	5°15.0′	7°52.50′	149.91	3.43	299.43	13.73	299.75	200.20	100.18
310	5°25.5′	8°24.53′	154.89	3.79	309.33	15.14	309.70	206.90	103.55
320	5°36.0′	8°57.60′	159.87	4.17	319.22	16.65	319.65	213.61	106.92
330	5°46.5′	9°31.73′	164.85	4.57	329.09	18.26	329.59	220.32	110.29
340	5°57.0′	10°06.90′	169.82	5.00	338.94	19.96	339.53	227.04	113.67
350	6°07.5′	10°43.13′	174.80	5.45	348.78	21.77	349.46	233.76	117.06
360	6°18.0′	11°20.40′	179.77	5.93	358.59	23.68	359.37	240.49	120.45
370	6°28.5′	11°58.73′	184.73	6.44	368.39	25.70	369.28	247.23	123.85
380	6°39.0′	12°38.10′	189.69	6.97	378.16	27.84	379.18	253.98	127.26
390	6°49.5′	13°18.53′	194.65	7.53	387.90	30.08	389.07	260.74	130.67
400	7°00.0′	14°00.00′	199.60	8.13	397.62	32.44	398.94	267.51	134.10
410	7°10.5′	14°42.53′	204.55	8.75	407.31	34.92	408.80	274.28	137.53
420	7°21.0′	15°26.10′	209.49	9.40	416.96	37.52	418.65	281.07	140.97
430	7°31.5′	16°10.73′	214.43	10.09	426.58	40.24	428.48	287.87	144.43
440	7°42.0′	16°56.40′	219.36	10.81	436.17	43.09	438.29	294.69	147.90
450	7°52.5′	17°43.13′	224.28	11.56	445.72	46.07	448.09	301.52	151.38
460	8°03.0′	18°30.90′	229.20	12.34	455.22	49.18	457.87	308.36	154.87
470	8°13.5′	19°19.73′	234.11	13.16	464.68	52.42	467.63	315.22	158.38
480	8°24.0′	20°09.60′	239.01	14.01	474.09	55.80	477.36	322.10	161.91
490	8°34.5′	21°00.53′	243.91	14.90	483.45	59.32	487.08	329.00	165.45
500	8°45.0′	21°52.50′	248.79	15.83	492.76	62.97	496.77	335.91	169.02

THE STANDARD HIGHWAY SPIRAL

a = 1.75—Continued

L	D	S	q	p	Y	X	C	U	V
510	8°55.5′	22°45.53′	253.66	16.79	502.01	66.77	506.43	342.85	172.60
520	9°06.0′	23°39.60′	258.53	17.79	511.20	70.71	516.07	349.81	176.20
530	9°16.5′	24°34.73′	263.38	18.82	520.33	74.80	525.68	356.80	179.82
540	9°27.0′	25°30.90′	268.22	19.90	529.39	79.03	535.26	363.81	183.47
550	9°37.5′	26°28.13′	273.06	21.01	538.38	83.41	544.80	370.85	187.14
560	9°48.0′	27°26.40′	277.87	22.17	547.29	87.94	554.31	377.92	190.84
570	9°58.5′	28°25.73′	282.68	23.36	556.13	92.63	563.79	385.02	194.57
580	10°09.0′	29°26.10′	287.47	24.60	564.88	97.47	573.23	392.15	198.33
590	10°19.5′	30°27.53′	292.24	25.88	573.54	102.46	582.62	399.32	202.12
600	10°30.0′	31°30.00′	297.00	27.19	582.12	107.60	591.98	406.52	205.94
610	10°40.5′	32°33.53′	301.75	28.56	590.59	112.91	601.29	413.77	209.80
620	10°51.0′	33°38.10′	306.47	29.96	598.97	118.37	610.56	421.05	213.70
630	11°01.5′	34°43.73′	311.18	31.41	607.24	123.99	619.77	428.38	217.64
640	11°12.0′	35°50.40′	315.87	32.90	615.41	129.76	628.94	435.75	221.62
650	11°22.5′	36°58.13′	320.54	34.43	623.46	135.70	638.05	443.18	225.64
660	11°33.0′	38°06.90′	325.19	36.01	631.39	141.79	647.11	450.65	229.71
670	11°43.5′	39°16.73′	329.82	37.64	639.19	148.04	656.11	458.18	233.84
680	11°54.0′	40°27.60′	334.43	39.31	646.86	154.45	665.05	465.77	238.01
690	12°04.5′	41°39.53′	339.01	41.03	654.41	161.02	673.92	473.42	242.25
700	12°15.0′	42°52.50′	343.57	42.79	661.81	167.75	682.73	481.13	246.54
710	12°25.5′	44°06.53′	348.10	44.60	669.06	174.63	691.47	488.91	250.89
720	12°36.0′	45°21.60′	352.61	46.45	676.16	181.67	700.14	496.77	255.31
730	12°46.5′	46°37.73′	357.09	48.35	683.11	188.86	708.74	504.70	259.81
740	12°57.0′	47°54.90′	361.54	50.30	689.90	196.20	717.25	512.71	264.37
750	13°07.5′	49°13.13′	365.96	52.30	696.51	203.70	725.69	520.80	269.01
760	13°18.0′	50°32.40′	370.35	54.34	702.96	211.35	734.04	528.99	273.74
770	13°28.5′	51°52.73′	374.71	56.43	709.22	219.14	742.31	537.26	278.55
780	13°39.0′	53°14.10′	379.04	58.56	715.30	227.08	750.48	545.64	283.46
790	13°49.5′	54°36.53′	383.34	60.75	721.19	235.16	758.56	554.13	288.47
800	14°00.0′	56°00.00′	387.60	62.98	726.88	243.38	766.55	562.72	293.57
810	14°10.5′	57°24.53′	391.82	65.26	732.37	251.74	774.43	571.43	298.79
820	14°21.0′	58°50.10′	396.00	67.58	737.65	260.23	782.21	580.27	304.12
830	14°31.5′	60°16.73′	400.15	69.96	742.72	268.85	789.88	589.24	309.58
840	14°42.0′	61°44.40′	404.26	72.38	747.57	277.60	797.45	598.35	315.17
850	14°52.5′	63°13.13′	408.32	74.84	752.19	286.47	804.89	607.60	320.89
860	15°03.0′	64°42.90′	412.35	77.36	756.58	295.45	812.22	617.01	326.76
870	15°13.5′	66°13.73′	416.33	79.92	760.73	304.55	819.43	626.59	332.78
880	15°24.0′	67°45.60′	420.27	82.52	764.64	313.75	826.51	636.34	338.97
890	15°34.5′	69°18.53′	424.16	85.17	768.30	323.06	833.46	646.28	345.34
900	15°45.0′	70°52.50′	428.00	87.87	771.70	332.46	840.27	656.41	351.88
910	15°55.5′	72°27.53′	431.79	90.61	774.85	341.95	846.95	666.76	358.63
920	16°06.0′	74°03.60′	435.54	93.39	777.73	351.53	853.48	677.33	365.59
930	16°16.5′	75°40.73′	439.23	96.22	780.34	361.18	859.87	688.13	372.77
940	16°27.0′	77°18.90′	442.87	99.09	782.67	370.91	866.11	699.19	380.19
950	16°37.5′	78°58.13′	446.46	102.00	784.73	380.69	872.20	710.51	387.86
960	16°48.0′	80°38.40′	449.99	104.96	786.50	390.53	878.12	722.13	395.80
970	16°58.5′	82°19.73′	453.47	107.95	787.98	400.42	883.89	734.05	404.04
980	17°09.0′	84°02.10′	456.89	110.99	789.17	410.35	889.48	746.29	412.59
990	17°19.5′	85°45.53′	460.25	114.06	790.06	420.31	894.90	758.89	421.47
1000	17°30.0′	87°30.00′	463.55	117.17	790.65	430.30	900.15	771.86	430.71

THE STANDARD HIGHWAY SPIRAL

a = 2.0

L	D	S	q	p	Y	X	C	U	V
10	0°12′	0°00.60′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°24′	0°02.40′	10.00	0.00	20.00	0.00	20.00	13.33	6.67
30	0°36′	0°05.40′	15.00	0.00	30.00	0.02	30.00	20.00	10.00
40	0°48′	0°09.60′	20.00	0.01	40.00	0.04	40.00	26.67	13.33
50	1°00′	0°15.00′	25.00	0.02	50.00	0.07	50.00	33.33	16.67
60	1°12′	0°21.60′	30.00	0.03	60.00	0.13	60.00	40.00	20.00
70	1°24′	0°29.40′	35.00	0.05	70.00	0.20	70.00	46.67	23.33
80	1°36′	0°38.40′	40.00	0.07	80.00	0.30	80.00	53.33	26.67
90	1°48′	0°48.60′	45.00	0.11	90.00	0.42	90.00	60.00	30.00
100	2°00′	1°00.00′	50.00	0.15	100.00	0.58	100.00	66.67	33.33
110	2°12′	1°12.60′	55.00	0.19	110.00	0.77	110.00	73.34	36.67
120	2°24′	1°26.40′	60.00	0.25	119.99	1.01	120.00	80.00	40.00
130	2°36′	1°41.40′	65.00	0.32	129.99	1.28	129.99	86.67	43.34
140	2°48′	1°57.60′	70.00	0.40	139.98	1.60	139.99	93.34	46.67
150	3°00′	2°15.00′	75.00	0.49	149.98	1.96	149.99	100.01	50.01
160	3°12′	2°33.60′	79.99	0.60	159.97	2.38	159.99	106.68	53.34
170	3°24′	2°53.40′	84.99	0.71	169.96	2.86	169.98	113.35	56.68
180	3°36′	3°14.40′	89.99	0.85	179.94	3.39	179.97	120.02	60.02
190	3°48′	3°36.60′	94.99	1.00	189.92	3.99	189.97	126.69	63.36
200	4°00′	4°00.00′	99.98	1.16	199.90	4.65	199.96	133.37	66.70
210	4°12′	4°24.60′	104.98	1.35	209.88	5.39	209.94	140.04	70.04
220	4°24′	4°50.40′	109.97	1.55	219.84	6.19	219.93	146.72	73.38
230	4°36′	5°17.40′	114.97	1.77	229.80	7.07	229.91	153.40	76.73
240	4°48′	5°45.60′	119.96	2.01	239.76	8.04	239.89	160.08	80.08
250	5°00′	6°15.00′	124.95	2.27	249.70	9.08	249.87	166.77	83.43
260	5°12′	6°45.60′	129.94	2.56	259.64	10.22	259.84	173.46	86.78
270	5°24′	7°17.40′	134.93	2.86	269.56	11.44	269.81	180.15	90.14
280	5°36′	7°50.40′	139.91	3.19	279.48	12.75	279.77	186.85	93.50
290	5°48′	8°24.60′	144.90	3.54	289.38	14.17	289.72	193.55	96.87
300	6°00′	9°00.00′	149.88	3.92	299.26	15.68	299.67	200.26	100.24
310	6°12′	9°36.60′	154.85	4.33	309.13	17.30	309.61	206.97	103.61
320	6°24′	10°14.40′	159.83	4.76	318.98	19.02	319.55	213.69	106.99
330	6°36′	10°53.40′	164.80	5.22	328.81	20.85	329.47	220.42	110.38
340	6°48′	11°33.60′	169.77	5.71	338.62	22.80	339.39	227.15	113.77
350	7°00′	12°15.00′	174.73	6.23	348.40	24.86	349.29	233.89	117.18
360	7°12′	12°57.60′	179.69	6.77	358.16	27.04	359.18	240.65	120.59
370	7°24′	13°41.40′	184.65	7.35	367.89	29.35	369.06	247.41	124.01
380	7°36′	14°26.40′	189.60	7.96	377.59	31.78	378.93	254.18	127.44
390	7°48′	15°12.60′	194.54	8.61	387.26	34.34	388.78	260.97	130.88
400	8°00′	16°00.00′	199.48	9.28	396.89	37.03	398.62	267.76	134.33
410	8°12′	16°48.60′	204.41	9.99	406.48	39.85	408.43	274.58	137.80
420	8°24′	17°38.40′	209.34	10.74	416.04	42.81	418.23	281.40	141.28
430	8°36′	18°29.40′	214.26	11.52	425.54	45.91	428.01	288.25	144.77
440	8°48′	19°21.60′	219.17	12.34	435.00	49.16	437.77	295.11	148.28
450	9°00′	20°15.00′	224.07	13.19	444.41	52.54	447.51	301.99	151.81
460	9°12′	21°09.60′	228.96	14.09	453.77	56.08	457.22	308.89	155.35
470	9°24′	22°05.40′	233.84	15.02	463.06	59.76	466.90	315.81	158.92
480	9°36′	23°02.40′	238.71	15.99	472.30	63.60	476.56	322.75	162.51
490	9°48′	24°00.60′	243.57	17.00	481.46	67.59	486.19	329.72	166.12
500	10°00′	25°00.00′	248.42	18.06	490.56	71.74	495.78	336.72	169.75

THE STANDARD HIGHWAY SPIRAL

a = 2.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	10°12′	26°00.60′	253.26	19.15	499.59	76.04	505.34	343.74	173.41
520	10°24′	27°02.40′	258.08	20.29	508.54	80.51	514.87	350.80	177.10
530	10°36′	28°05.40′	262.89	21.47	517.40	85.14	524.36	357.89	180.81
540	10°48′	29°09.60′	267.69	22.69	526.18	89.93	533.81	365.01	184.56
550	11°00′	30°15.00′	272.46	23.96	534.87	94.88	543.22	372.17	188.34
560	11°12′	31°21.60′	277.23	25.27	543.45	100.00	552.58	379.36	192.16
570	11°24′	32°29.40′	281.97	26.63	551.94	105.29	561.90	386.60	196.02
580	11°36′	33°38.40′	286.70	28.03	560.32	110.75	571.16	393.89	199.91
590	11°48′	34°48.60′	291.41	29.48	568.59	116.37	580.38	401.22	203.85
600	12°00′	36°00.00′	296.10	30.98	576.74	122.16	589.54	408.60	207.84
610	12°12′	37°12.60′	300.76	32.52	584.77	128.13	598.64	416.03	211.87
620	12°24′	38°26.40′	305.41	34.11	592.67	134.26	607.69	423.52	215.96
630	12°36′	39°41.40′	310.03	35.75	600.43	140.56	616.67	431.07	220.10
640	12°48′	40°57.60′	314.63	37.44	608.06	147.03	625.58	438.68	224.29
650	13°00′	42°15.00′	319.20	39.18	615.53	153.67	634.43	446.36	228.55
660	13°12′	43°33.60′	323.74	40.96	622.86	160.48	643.20	454.10	232.88
670	13°24′	44°53.40′	328.26	42.80	630.03	167.45	651.90	461.93	237.27
680	13°36′	46°14.40′	332.75	44.68	637.03	174.59	660.52	469.83	241.74
690	13°48′	47°36.60′	337.21	46.62	643.86	181.90	669.06	477.82	246.28
700	14°00′	49°00.00′	341.64	48.60	650.51	189.36	677.51	485.90	250.91
710	14°12′	50°24.60′	346.03	50.64	656.97	196.99	685.87	494.07	255.62
720	14°24′	51°50.40′	350.40	52.73	663.25	204.78	694.14	502.34	260.43
730	14°36′	53°17.40′	354.72	54.86	669.33	212.72	702.32	510.72	265.34
740	14°48′	54°45.60′	359.02	57.05	675.20	220.81	710.39	519.21	270.35
750	15°00′	56°15.00′	363.27	59.29	680.87	229.05	718.36	527.82	275.48
760	15°12′	57°45.60′	367.48	61.58	686.31	237.44	726.22	536.56	280.72
770	15°24′	59°17.40′	371.66	63.92	691.53	245.96	733.97	545.43	286.08
780	15°36′	60°50.40′	375.79	66.31	696.52	254.63	741.61	554.45	291.58
790	15°48′	62°24.60′	379.88	68.75	701.28	263.43	749.12	563.62	297.23
800	16°00′	64°00.00′	383.93	71.24	705.79	272.35	756.51	572.95	303.02
810	16°12′	65°36.60′	387.93	73.77	710.04	281.40	763.77	582.45	308.98
820	16°24′	67°14.40′	391.88	76.36	714.04	290.57	770.90	592.14	315.10
830	16°36′	68°53.40′	395.79	79.00	717.78	299.84	777.89	602.02	321.41
840	16°48′	70°33.60′	399.64	81.68	721.24	309.22	784.74	612.11	327.92
950	17°00′	72°15.00′	403.44	84.42	724.43	318.70	791.44	622.42	334.63
860	17°12′	73°57.60′	407.19	87.20	727.34	328.27	797.99	632.96	341.57
870	17°24′	75°41.40′	410.89	90.02	729.96	337.92	804.38	643.76	348.74
880	17°36′	77°26.40′	414.53	92.89	732.28	347.64	810.61	654.83	356.17
890	17°48′	79°12.60′	418.11	95.81	734.30	357.44	816.68	666.18	363.87
900	18°00′	81°00.00′	421.63	98.77	736.02	367.29	822.58	677.85	371.87
910	18°12′	82°48.60′	425.09	101.78	737.43	377.19	828.30	689.85	380.18
920	18°24′	84°38.40′	428.50	104.83	738.52	387.13	833.84	702.20	388.83
930	18°36′	86°29.40′	431.83	107.91	739.30	397.10	839.19	714.94	397.84
940	18°48′	88°21.60′	435.11	111.04	739.75	407.09	844.36	728.09	407.25
950	19°00′	90°15.00′	438.32	114.21	739.87	417.09	849.33	741.69	417.09
960	19°12′	92°09.60′	441.46	117.42	739.66	427.08	854.10	755.77	427.39
970	19°24′	94°05.40′	444.53	120.66	739.11	437.07	858.67	770.37	438.18
980	19°36′	96°02.40′	447.53	123.94	738.23	447.03	863.03	785.53	449.52
990	19°48′	98°00.60′	450.46	127.26	737.01	456.95	867.17	801.31	461.45
1000	20°00′	100°00.00′	453.32	130.60	735.44	466.83	871.10	817.76	474.03

THE STANDARD HIGHWAY SPIRAL

a = 2.5

L	D	S	q	p	Y	X	C	U	V
10	0°15′	0°00.75′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°30′	0°03.00′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	0°45′	0°06.75′	15.00	0.00	30.00	0.02	30.00	20.00	10.00
40	1°00′	0°12.00′	20.00	0.01	40.00	0.05	40.00	26.67	13.33
50	1°15′	0°18.75′	25.00	0.02	50.00	0.09	50.00	33.33	16.67
60	1°30′	0°27.00′	30.00	0.04	60.00	0.16	60.00	40.00	20.00
70	1°45′	0°36.75′	35.00	0.06	70.00	0.25	70.00	46.67	23.33
80	2°00′	0°48.00′	40.00	0.09	80.00	0.37	80.00	53.33	26.67
90	2°15′	1°00.75′	45.00	0.13	90.00	0.53	90.00	60.00	30.00
100	2°30′	1°15.00′	50.00	0.18	100.00	0.73	100.00	66.67	33.33
110	2°45′	1°30.75′	55.00	0.24	109.99	0.97	110.00	73.34	36.67
120	3°00′	1°48.00′	60.00	0.31	119.99	1.26	119.99	80.00	40.00
130	3°15′	2°06.75′	65.00	0.40	129.98	1.60	129.99	86.67	43.34
140	3°30′	2°27.00′	70.00	0.50	139.97	2.00	139.99	93.34	46.67
150	3°45′	2°48.75′	74.99	0.61	149.96	2.45	149.98	100.01	50.01
160	4°00′	3°12.00′	79.99	0.74	159.95	2.98	159.98	106.68	53.35
170	4°15′	3°36.75′	84.99	0.89	169.93	3.57	169.97	113.36	56.69
180	4°30′	4°03.00′	89.99	1.06	179.91	4.24	179.96	120.03	60.03
190	4°45′	4°30.75′	94.98	1.25	189.88	4.99	189.95	126.71	63.37
200	5°00′	5°00.00′	99.97	1.45	199.85	5.81	199.93	133.39	66.72
210	5°15′	5°30.75′	104.97	1.68	209.81	6.73	209.91	140.07	70.06
220	5°30′	6°03.00′	109.96	1.94	219.75	7.74	219.89	146.75	73.41
230	5°45′	6°36.75′	114.95	2.21	229.69	8.84	229.86	153.44	76.76
240	6°00′	7°12.00′	119.94	2.51	239.62	10.04	239.83	160.13	80.12
250	6°15′	7°48.75′	124.92	2.84	249.54	11.35	249.79	166.83	83.48
260	6°30′	8°27.00′	129.91	3.19	259.44	12.76	259.75	173.53	86.85
270	6°45′	9°06.75′	134.89	3.58	269.32	14.29	269.70	180.24	90.22
280	7°00′	9°48.00′	139.86	3.99	279.18	15.93	279.64	186.95	93.59
290	7°15′	10°30.75′	144.84	4.43	289.03	17.69	289.57	193.68	96.98
300	7°30′	11°15.00′	149.81	4.90	298.85	19.58	299.49	200.41	100.37
310	7°45′	12°00.75′	154.77	5.41	308.64	21.60	309.39	207.14	103.77
320	8°00′	12°48.00′	159.73	5.95	318.41	23.74	319.29	213.89	107.18
330	8°15′	13°36.75′	164.69	6.52	328.14	26.03	329.17	220.65	110.59
340	8°30′	14°27.00′	169.64	7.13	337.84	28.45	339.04	227.43	114.02
350	8°45′	15°18.75′	174.58	7.78	347.51	31.02	348.89	234.21	117.47
360	9°00′	16°12.00′	179.52	8.46	357.13	33.74	358.72	241.01	120.92
370	9°15′	17°06.75′	184.45	9.18	366.71	36.60	368.54	247.83	124.39
380	9°30′	18°03.00′	189.37	9.94	376.25	39.62	378.33	254.66	127.88
390	9°45′	19°00.75′	194.29	10.74	385.73	42.80	388.09	261.52	131.38
400	10°00′	20°00.00′	199.19	11.59	395.15	46.14	397.84	268.39	134.90
410	10°15′	21°00.75′	204.08	12.47	404.52	49.64	407.55	275.28	138.44
420	10°30′	22°03.00′	208.97	13.40	413.82	53.31	417.24	282.20	142.01
430	10°45′	23°06.75′	213.84	14.37	423.06	57.15	426.90	289.15	145.59
440	11°00′	24°12.00′	218.70	15.39	432.22	61.16	43.652	296.12	149.21
450	11°15′	25°18.75′	223.54	16.45	441.30	65.35	446.11	303.13	152.85
460	11°30′	26°27.00′	228.38	17.56	450.29	69.71	455.66	310.16	156.52
470	11°45′	27°36.75′	233.19	18.72	459.20	74.26	465.17	317.23	160.22
480	12°00′	28°48.00′	237.99	19.93	468.01	78.98	474.63	324.34	163.95
490	12°15′	30°00.75′	242.78	21.18	476.72	83.89	484.05	331.49	167.73
500	12°30′	31°15.00′	247.54	22.49	485.33	88.99	493.42	338.68	171.54

THE STANDARD HIGHWAY SPIRAL

a = 2.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	12°45′	32°30.75′	252.29	23.84	493.82	94.27	502.74	345.92	175.39
520	13°00′	33°48.00′	257.01	25.25	502.19	99.74	512.00	353.20	179.29
530	13°15′	35°06.75′	261.72	26.71	510.44	105.40	521.21	360.54	183.24
540	13°30′	36°27.00′	266.40	28.22	518.55	111.24	530.35	367.94	187.24
550	13°45′	37°48.75′	271.06	29.78	526.52	117.28	539.43	375.40	191.30
560	14°00′	39°12.00′	275.69	31.40	534.35	123.50	548.44	382.92	195.41
570	14°15′	40°36.75′	280.29	33.07	542.02	129.92	557.37	390.51	199.59
580	14°30′	42°03.00′	284.87	34.80	549.53	136.52	566.23	398.17	203.83
590	14°45′	43°30.75′	289.42	36.58	556.87	143.31	575.01	405.91	208.15
600	15°00′	45°00.00′	293.94	38.42	564.03	150.29	583.71	413.74	212.55
610	15°15′	46°30.75′	298.42	40.31	571.01	157.46	592.32	421.65	217.02
620	15°30′	48°03.00′	302.87	42.26	577.79	164.80	600.84	429.66	221.59
630	15°45′	49°36.75′	307.29	44.26	584.38	172.33	609.26	437.78	226.25
640	16°00′	51°12.00′	311.67	46.32	590.75	180.04	617.57	446.00	231.01
650	16°15′	52°48.75′	316.01	48.44	596.90	187.92	625.79	454.33	235.88
660	16°30′	54°27.00′	320.31	60.61	602.83	195.97	633.89	462.79	240.86
670	16°45′	56°06.75′	324.57	52.84	608.53	204.19	641.87	471.39	245.97
680	17°00′	57°48.00′	328.79	55.13	613.98	212.57	649.74	480.12	251.21
690	17°15′	59°30.75′	332.96	57.48	619.18	221.11	657.48	489.01	256.58
700	17°30′	61°15.00′	337.08	59.87	624.13	229.80	665.09	498.05	262.11
710	17°45′	63°00.75′	341.16	62.33	628.80	238.64	672.56	507.27	267.80
720	18°00′	64°48.00′	345.18	64.84	633.20	247.62	679.90	516.68	273.67
730	18°15′	66°36.75′	349.16	67.41	637.31	256.74	687.08	526.28	279.72
740	18°30′	68°27.00′	353.08	70.03	641.14	265.98	694.12	536.10	285.97
750	18°45′	70°18.75′	356.94	72.70	644.66	275.33	700.99	546.14	292.43
760	19°00′	72°12.00′	360.75	75.43	647.87	284.80	707.71	556.43	299.12
770	19°15′	74°06.75′	364.50	78.21	650.77	294.37	714.25	566.98	306.07
780	19°30′	76°03.00′	368.19	81.05	653.34	304.04	720.62	577.82	313.28
790	19°45′	78°00.75′	371.81	83.93	655.59	313.78	726.81	588.96	320.78
800	20°00′	80°00.00′	375.37	86.86	657.50	323.60	732.81	600.44	328.59
810	20°15′	82°00.75′	378.86	89.85	659.06	333.47	738.62	612.27	336.74
820	20°30′	84°03.00′	382.29	92.88	660.27	343.40	744.23	624.48	345.26
830	20°45′	86°06.75′	385.64	95.96	661.13	353.36	749.64	637.12	354.18
840	21°00′	88°12.00′	388.92	99.08	661.63	363.35	754.83	650.21	363.53
850	21°15′	90°18.75′	392.13	102.25	661.76	373.35	759.81	663.79	373.35
860	21°30′	92°27.00′	395.27	105.46	661.52	383.34	764.56	677.92	383.69
870	21°45′	94°36.75′	398.33	108.71	660.90	393.32	769.09	692.63	394.60
880	22°00′	96°48.00′	401.30	112.00	659.91	403.27	773.37	707.99	406.13
890	22°15′	99°00.75′	404.20	115.33	658.53	413.18	777.42	724.07	418.34
900	22°30′	101°15.00′	407.02	118.69	656.77	423.02	781.22	740.92	431.31

THE STANDARD HIGHWAY SPIRAL

a = 3.0

L	D	S	q	p	Y	X	C	U	V
10	0°18′	0°00.90′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°36′	0°03.60′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	0°54′	0°08.10′	15.00	0.01	30.00	0.02	30.00	20.00	10.00
40	1°12′	0°14.40′	20.00	0.01	40.00	0.06	40.00	26.67	13.33
50	1°30′	0°22.50′	25.00	0.03	50.00	0.11	50.00	33.33	16.67
60	1°48′	0°32.40′	30.00	0.05	60.00	0.19	60.00	40.00	20.00
70	2°06′	0°44.10′	35.00	0.07	70.00	0.30	70.00	46.67	23.33
80	2°24′	0°57.60′	40.00	0.11	80.00	0.45	80.00	53.33	26.67
90	2°42′	1°12.90′	45.00	0.16	90.00	0.64	90.00	60.00	30.00
100	3°00′	1°30.00′	50.00	0.22	99.99	0.87	100.00	66.67	33.34
110	3°18′	1°48.90′	55.00	0.29	109.99	1.16	110.00	73.34	36.67
120	3°36′	2°09.60′	60.00	0.38	119.98	1.51	119.99	80.01	40.01
130	3°54′	2°32.10′	65.00	0.48	129.97	1.92	129.99	86.68	43.34
140	4°12′	2°56.40′	69.99	0.60	139.96	2.39	139.96	93.35	46.68
150	4°30′	3°22.50′	74.99	0.74	149.95	2.94	149.96	100.02	50.02
160	4°48′	3°50.40′	79.99	0.89	159.93	3.57	159.97	106.69	53.36
170	5°06′	4°20.10′	84.98	1.07	169.90	4.29	169.96	113.37	56.70
180	5°24′	4°51.60′	89.98	1.27	179.87	5.09	179.94	120.05	60.04
190	5°42′	5°24.90′	94.97	1.50	189.83	5.98	189.92	126.73	63.39
200	6°00′	6°00.00′	99.96	1.74	199.78	6.98	199.90	133.41	66.74
210	6°18′	6°36.90′	104.95	2.02	209.72	8.07	209.88	140.10	70.09
220	6°36′	7°15.60′	109.94	2.32	219.65	9.28	219.84	146.79	73.45
230	6°54′	7°56.10′	114.93	2.65	229.56	10.60	229.80	153.49	76.81
240	7°12′	8°38.40′	119.91	3.01	239.45	12.04	239.76	160.19	80.17
250	7°30′	9°22.50′	124.89	3.41	249.33	13.61	249.70	166.90	83.55
260	7°48′	10°08.40′	129.86	3.83	259.19	15.30	259.64	173.62	86.93
270	8°06′	10°56.10′	134.84	4.29	269.02	17.13	269.56	180.34	90.31
280	8°24′	11°45.60′	139.80	4.78	278.82	19.10	279.48	187.08	93.71
290	8°42′	12°36.90′	144.77	5.31	288.60	21.21	289.38	193.83	97.12
300	9°00′	13°30.00′	149.72	5.88	298.34	23.47	299.26	200.58	100.53
310	9°18′	14°24.90′	154.67	6.48	308.04	25.88	309.13	207.36	103.96
320	9°36′	15°21.60′	159.62	7.13	317.71	28.45	318.98	214.14	107.40
330	9°54′	16°20.10′	164.55	7.82	327.33	31.18	328.81	220.94	110.86
340	10°12′	17°20.40′	169.48	8.55	336.90	34.08	338.62	227.76	114.33
350	10°30′	18°22.50′	174.40	9.32	346.42	37.14	348.40	234.60	117.82
360	10°48′	19°26.40′	179.31	10.14	355.88	40.38	358.16	241.46	121.33
370	11°06′	20°32.10′	184.21	11.00	365.28	43.80	367.89	248.35	124.86
380	11°24′	21°39.60′	189.10	11.91	374.61	47.40	377.59	255.26	128.42
390	11°42′	22°48.90′	193.97	12.87	383.86	51.18	387.26	262.19	132.00
400	12°00′	24°00.00′	198.84	13.88	393.04	55.15	396.89	269.16	135.60
410	12°18′	25°12.90′	203.68	14.93	402.13	59.32	406.48	276.16	139.24
420	12°36′	26°27.60′	208.52	16.04	411.13	63.68	416.03	283.19	142.91
430	12°54′	27°44.10′	213.33	17.20	420.03	68.23	425.54	290.27	146.61
440	13°12′	29°02.40′	218.13	18.41	428.83	72.98	435.00	297.38	150.35
450	13°30′	30°22.50′	222.91	19.68	437.52	77.94	444.40	304.54	154.13
460	13°48′	31°44.40′	227.67	21.00	446.08	83.10	453.76	311.75	157.96
470	14°06′	33°08.10′	232.40	22.38	454.52	88.46	463.05	319.00	161.83
480	14°24′	34°33.60′	237.12	23.82	462.83	94.03	472.28	326.32	165.76
490	14°42′	36°00.90′	241.81	25.31	470.99	99.81	481.45	333.69	169.74
500	15°00′	37°30.00′	246.47	26.86	479.00	105.79	490.55	341.13	173.78

THE STANDARD HIGHWAY SPIRAL

a = 3.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	15°18′	39°00.90′	251.11	28.47	486.85	111.98	499.57	348.64	177.88
520	15°36′	40°33.60′	255.72	30.13	494.54	118.38	508.51	356.23	182.06
530	15°54′	42°08.10′	260.29	31.86	502.05	124.99	517.37	363.89	186.30
540	16°12′	43°44.40′	264.84	33.65	509.37	131.80	526.14	371.64	190.63
550	16°30′	45°22.50′	269.35	35.50	516.49	138.81	534.82	379.48	195.04
560	16°48′	47°02.40′	273.83	37.40	523.41	146.03	543.40	387.43	199.54
570	17°06′	48°44.10′	278.26	39.37	530.12	153.45	551.88	395.48	204.15
580	17°24′	50°27.60′	282.66	41.41	536.60	161.06	560.25	403.64	208.85
590	17°42′	52°12.90′	287.02	43.50	542.85	168.87	568.51	411.93	213.68
600	18°00′	54°00.00′	291.33	45.66	548.85	176.87	576.65	420.35	218.62
610	18°18′	55°48.90′	295.60	47.87	554.60	185.05	584.66	428.91	223.70
620	18°36′	57°39.60′	299.82	50.15	560.09	193.41	592.54	437.63	228.92
630	18°54′	59°32.10′	304.00	52.50	565.30	201.95	600.28	446.51	234.29
640	19°12′	61°26.40′	308.12	54.90	570.22	210.65	607.89	455.56	239.83
650	19°30′	63°22.50′	312.19	57.36	574.85	219.51	615.34	464.81	245.55
660	19°48′	65°20.40′	316.20	59.89	579.18	228.52	622.64	474.27	251.46
670	20°06′	67°20.10′	320.16	62.47	583.20	237.68	629.77	483.94	257.57
680	20°24′	69°21.60′	324.05	65.12	586.89	246.98	636.74	493.86	263.92
690	20°42′	71°24.90′	327.89	67.82	590.24	256.40	643.53	504.03	270.50
700	21°00′	73°30.00′	331.66	70.58	593.26	265.93	650.13	514.48	277.35
710	21°18′	75°36.90′	335.36	73.40	595.92	275.57	656.55	525.24	284.49
720	21°36′	77°45.60′	338.99	76.28	598.22	285.30	662.77	536.33	291.94
730	21°54′	79°56.10′	342.56	79.21	600.16	295.11	668.79	547.78	299.72
740	22°12′	82°08.40′	346.05	82.19	601.72	304.99	674.60	559.61	307.88
750	22°30′	84°22.50′	349.47	85.23	602.89	314.92	680.18	571.87	316.44
760	22°48′	86°38.40′	352.81	88.32	603.67	324.89	685.55	584.60	325.45
770	23°06′	88°56.10′	356.07	91.45	604.06	334.88	690.67	597.83	334.94
780	23°24′	91°15.60′	359.25	94.64	604.04	344.88	695.56	611.63	344.96
790	23°42′	93°36.90′	362.35	97.87	603.62	354.87	700.20	626.04	355.57
800	24°00′	96°00.00′	365.36	101.14	602.78	364.83	704.59	641.13	366.84
810	24°18′	98°24.90′	368.28	104.46	601.53	374.75	708.71	656.97	378.83
820	24°36′	100°51.60′	371.12	107.82	599.85	384.61	712.56	673.64	391.62

THE STANDARD HIGHWAY SPIRAL

a = 3.5

L	D	S	q	p	Y	X	C	U	V
10	0°21′	0°01.05′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°42′	0°04.20′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°03′	0°09.45′	15.00	0.01	30.00	0.03	30.00	20.00	10.00
40	1°24′	0°16.80′	20.00	0.02	40.00	0.07	40.00	26.67	13.33
50	1°45′	0°26.25′	25.00	0.03	50.00	0.13	50.00	33.33	16.67
60	2°06′	0°37.80′	30.00	0.05	60.00	0.22	60.00	40.00	20.00
70	2°27′	0°51.45′	35.00	0.09	70.00	0.35	70.00	46.67	23.33
80	2°48′	1°07.20′	40.00	0.13	80.00	0.52	80.00	53.33	26.67
90	3°09′	1°25.05′	45.00	0.19	89.99	0.74	90.00	60.00	30.00
100	3°30′	1°45.00′	50.00	0.25	99.99	1.02	100.00	66.67	33.34
110	3°51′	2°07.05′	55.00	0.34	109.98	1.35	109.99	73.34	36.67
120	4°12′	2°31.20′	60.00	0.44	119.98	1.76	119.99	80.01	40.01
130	4°33′	2°57.45′	64.99	0.56	129.97	2.24	129.98	86.68	43.34
140	4°54′	3°25.80′	69.99	0.70	139.95	2.79	139.98	93.35	46.68
150	5°15′	3°56.25′	74.99	0.86	149.93	3.43	149.97	100.02	50.02
160	5°36′	4°28.80′	79.98	1.04	159.90	4.17	159.96	106.70	53.36
170	5°57′	5°03.45′	84.98	1.25	169.87	5.00	169.94	113.38	56.71
180	6°18′	5°40.20′	89.97	1.48	179.82	5.93	179.92	120.06	60.06
190	6°39′	6°19.05′	94.96	1.75	189.77	6.98	189.90	126.75	63.41
200	7°00′	7°00.00′	99.95	2.04	199.70	8.14	199.87	133.44	66.76
210	7°21′	7°43.05′	104.94	2.36	209.62	9.42	209.83	140.13	70.12
220	7°42′	8°28.20′	109.92	2.71	219.52	10.82	219.79	146.83	73.49
230	8°03′	9°15.45′	114.90	3.09	229.40	12.36	229.73	153.54	76.86
240	8°24′	10°04.80′	119.88	3.51	239.26	14.04	239.67	160.26	80.24
250	8°45′	10°56.25′	124.85	3.97	249.09	15.87	249.60	166.99	83.62
260	9°06′	11°49.80′	129.82	4.47	258.89	17.84	259.51	173.72	87.02
270	9°27′	12°45.45′	134.78	5.00	268.66	19.97	269.41	180.47	90.43
280	9°48′	13°43.20′	139.73	5.58	278.40	22.26	279.29	187.23	93.85
290	10°09′	14°43.05′	144.68	6.19	288.09	24.71	289.15	194.01	97.28
300	10°30′	15°45.00′	149.62	6.85	297.74	27.34	298.99	200.80	100.73
310	10°51′	16°49.05′	154.56	7.56	307.34	30.14	308.81	207.61	104.19
320	11°12′	17°55.20′	159.48	8.31	316.88	33.13	318.61	214.44	107.67
330	11°33′	19°03.45′	164.39	9.11	326.37	36.30	328.38	221.29	111.17
340	11°54′	20°13.80′	169.30	9.96	335.79	39.66	338.12	228.16	114.70
350	12°15′	21°26.25′	174.19	10.86	345.13	43.22	347.83	235.07	118.24
360	12°36′	22°40.80′	179.06	11.81	354.40	46.97	357.50	242.00	121.82
370	12°57′	23°57.45′	183.93	12.81	363.58	50.93	367.13	248.96	125.42
380	13°18′	25°16.20′	188.77	13.87	372.67	55.09	376.72	255.96	129.06
390	13°39′	26°37.05′	193.61	14.98	381.67	59.47	386.27	263.00	132.73
400	14°00′	28°00.00′	198.42	16.15	390.55	64.06	395.77	270.08	136.44
410	14°21′	29°25.05′	203.21	17.38	399.32	68.86	405.22	277.21	140.19
420	14°42′	30°52.20′	207.98	18.66	407.97	73.88	414.61	284.38	143.99
430	15°03′	32°21.45′	212.73	20.01	416.49	79.12	423.94	291.61	147.83
440	15°24′	33°52.80′	217.46	21.41	424.86	84.58	433.20	298.89	151.73
450	15°45′	35°26.25′	222.16	22.88	433.09	90.27	442.40	306.24	155.69
460	16°06′	37°01.80′	226.83	24.41	441.15	96.18	451.52	313.66	159.71
470	16°27′	38°39.45′	231.48	26.00	449.05	102.32	460.56	321.15	163.79
480	16°48′	40°19.20′	236.09	27.66	456.77	108.67	469.52	328.71	167.95
490	17°09′	42°01.05′	240.67	29.38	464.30	115.26	478.39	336.37	172.19
500	17°30′	43°45.00′	245.22	31.16	471.62	122.06	487.16	344.12	176.51

THE STANDARD HIGHWAY SPIRAL

a = 3.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	17°51′	45°31.05′	249.73	33.01	478.74	129.09	495.84	351.96	180.93
520	18°12′	47°19.20′	254.20	34.93	485.63	136.33	504.41	359.92	185.44
530	18°33′	49°09.45′	258.63	36.91	492.29	143.79	512.86	367.99	190.07
540	18°54′	51°01.80′	263.02	38.96	498.71	151.46	521.20	376.19	194.81
550	19°15′	52°56.25′	267.36	41.08	504.87	159.34	529.41	384.53	199.67
560	19°36′	54°52.80′	271.65	43.26	510.76	167.42	537.50	393.01	204.68
570	19°57′	56°51.45′	275.90	45.51	516.37	175.69	545.44	401.65	209.83
580	20°18′	58°52.20′	280.09	47.83	521.69	184.16	553.24	410.47	215.14
590	20°39′	60°55.05′	284.23	50.21	526.71	192.81	560.89	419.47	220.63
600	21°00′	63°00.00′	288.31	52.66	531.41	201.64	568.38	428.67	226.30
610	21°21′	65°07.05′	292.33	55.18	535.78	210.63	575.70	438.09	232.18
620	21°42′	67°16.20′	296.29	57.76	539.82	219.78	582.84	447.75	238.28
630	22°03′	69°27.45′	300.18	60.41	543.51	229.07	589.81	457.67	244.63
640	22°24′	71°40.80′	304.01	63.11	546.83	238.50	596.58	467.86	251.23
650	22°45′	73°56.25′	307.77	65.89	549.79	248.05	603.16	478.37	258.13
660	23°06′	76°13.80′	311.46	68.72	552.36	257.71	609.53	489.21	265.34
670	23°27′	78°33.45′	315.07	71.61	554.55	267.47	615.68	500.41	272.90
680	23°48′	80°55.20′	318.61	74.57	556.33	277.31	621.61	512.01	280.83
690	24°09′	83°19.05′	322.06	77.58	557.70	287.22	627.31	524.05	289.18
700	24°30′	85°45.00′	325.44	80.64	558.65	297.17	632.77	536.57	297.99
710	24°51′	88°13.05′	328.72	83.76	559.18	307.16	637.99	549.62	307.30
720	25°12′	90°43.20′	331.93	86.93	559.27	317.15	642.94	563.26	317.18
730	25°33′	93°15.45′	335.04	90.16	558.93	327.15	647.63	577.55	327.68
740	25°54′	95°49.80′	338.06	93.43	558.13	337.12	652.04	592.56	338.87
750	26°15′	98°26.25′	340.99	96.74	556.89	347.04	656.17	608.37	350.83
760	26°36′	101°04.80′	343.82	100.10	555.20	356.89	660.01	625.09	363.67

THE STANDARD HIGHWAY SPIRAL

a = 4.0

L	D	S	q	p	Y	X	C	U	V
10	0°24′	0°01.20′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°48′	0°04.80′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°12′	0°10.80′	15.00	0.01	30.00	0.03	30.00	20.00	10.00
40	1°36′	0°19.20′	20.00	0.02	40.00	0.07	40.00	26.67	13.33
50	2°00′	0°30.00′	25.00	0.04	50.00	0.15	50.00	33.33	16.67
60	2°24′	0°43.20′	30.00	0.06	60.00	0.25	60.00	40.00	20.00
70	2°48′	0°58.80′	35.00	0.10	70.00	0.40	70.00	46.67	23.33
80	3°12′	1°16.80′	40.00	0.15	80.00	0.60	80.00	53.33	26.67
90	3°36′	1°37.20′	45.00	0.21	89.99	0.85	90.00	60.00	30.00
100	4°00′	2°00.00′	50.00	0.29	99.99	1.16	99.99	66.67	33.34
110	4°24′	2°25.20′	55.00	0.39	109.98	1.55	109.99	73.34	36.67
120	4°48′	2°52.80′	59.99	0.50	119.97	2.01	119.99	80.01	40.01
130	5°12′	3°22.80′	64.99	0.64	129.95	2.56	129.98	86.68	43.35
140	5°36′	3°55.20′	69.99	0.80	139.93	3.19	139.97	93.36	46.69
150	6°00′	4°30.00′	74.98	0.98	149.91	3.93	149.96	100.03	50.03
160	6°24′	5°07.20′	79.98	1.19	159.87	4.76	159.94	106.71	53.37
170	6°48′	5°46.80′	84.97	1.43	169.83	5.71	169.92	113.39	56.72
180	7°12′	6°28.80′	89.96	1.70	179.77	6.78	179.90	120.08	60.07
190	7°36′	7°13.20′	94.95	1.99	189.70	7.97	189.87	126.77	63.43
200	8°00′	8°00.00′	99.94	2.33	199.61	9.30	199.83	133.47	66.79
210	8°24′	8°49.20′	104.92	2.69	209.50	10.76	209.78	140.17	70.16
220	8°48′	9°40.80′	109.90	3.09	219.37	12.36	219.72	146.89	73.53
230	9°12′	10°34.80′	114.87	3.53	229.22	14.12	229.65	153.61	76.92
240	9°36′	11°31.20′	119.84	4.02	239.03	16.04	239.57	160.34	80.31
250	10°00′	12°30.00′	124.80	4.54	248.81	18.12	249.47	167.08	83.71
260	10°24′	13°31.20′	129.76	5.10	258.56	20.37	259.36	173.84	87.13
270	10°48′	14°34.80′	134.71	5.71	268.26	22.80	269.22	180.61	90.56
280	11°12′	15°40.80′	139.65	6.37	277.91	25.41	279.07	187.40	94.00
290	11°36′	16°49.20′	144.58	7.07	287.51	28.20	288.89	194.21	97.47
300	12°00′	18°00.00′	149.51	7.83	297.05	31.20	298.69	201.04	100.95
310	12°24′	19°13.20′	154.42	8.63	306.53	34.39	308.45	207.90	104.45
320	12°48′	20°28.80′	159.32	9.49	315.94	37.78	318.19	214.78	107.98
330	13°12′	21°46.80′	164.21	10.40	325.26	41.38	327.89	221.69	111.54
340	13°36′	23°07.20′	169.08	11.37	334.51	45.20	337.55	228.63	115.12
350	14°00′	24°30.00′	173.94	12.39	343.65	49.24	347.16	235.61	118.74
360	14°24′	25°55.20′	178.78	13.47	352.70	53.50	356.74	242.62	122.39
370	14°48′	27°22.80′	183.60	14.61	361.64	57.98	366.26	249.68	126.08
380	15°12′	28°52.80′	188.40	15.82	370.46	62.70	375.73	256.79	129.81
390	15°36′	30°25.20′	193.18	17.08	379.15	67.64	385.14	263.95	133.59
400	16°00′	32°00.00′	197.94	18.41	387.70	72.82	394.48	271.16	137.43
410	16°24′	33°37.20′	202.67	19.80	396.11	78.24	403.76	278.43	141.31
420	16°48′	35°16.80′	207.37	21.26	404.35	83.90	412.97	285.77	145.26
430	17°12′	36°58.80′	212.05	22.79	412.43	89.79	422.09	293.18	149.27
440	17°36′	38°43.20′	216.69	24.38	420.33	95.93	431.13	300.67	153.36
450	18°00′	40°30.00′	221.30	26.04	428.03	102.30	440.09	308.25	157.52
460	18°24′	42°19.20′	225.88	27.77	435.53	108.92	448.94	315.91	161.77
470	18°48′	44°10.80′	230.42	29.57	442.81	115.77	457.70	323.68	166.12
480	19°12′	46°04.80′	234.92	31.44	449.87	122.86	466.34	331.56	170.56
490	19°36′	48°01.20′	239.37	33.38	456.68	130.17	474.87	339.56	175.11
500	20°00′	50°00.00′	243.79	35.39	463.24	137.72	483.28	347.68	179.78

THE STANDARD HIGHWAY SPIRAL

a = 4.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	20°24′	52°01.20′	248.15	37.47	469.53	145.49	491.56	355.94	184.58
520	20°48′	54°04.80′	252.47	39.62	475.55	153.48	499.70	364.36	189.52
530	21°12′	56°10.80′	256.73	41.85	481.26	161.69	507.70	372.94	194.62
540	21°36′	58°19.20′	260.94	44.15	486.67	170.10	515.54	381.70	199.88
550	22°00′	60°30.00′	265.09	46.51	491.76	178.71	523.23	390.66	205.32
560	22°24′	62°43.20′	269.18	48.95	496.52	187.50	530.74	399.82	210.97
570	22°48′	64°58.80′	273.21	51.46	500.92	196.48	538.08	409.22	216.82
580	23°12′	67°16.80′	277.17	54.04	504.97	205.62	545.23	418.87	222.92
590	23°36′	69°37.20′	281.06	56.69	508.64	214.92	552.19	428.80	229.27
600	24°00′	72°00.00′	284.88	59.40	511.93	224.36	558.94	439.03	235.91
610	24°24′	74°25.20′	288.63	62.19	514.82	233.94	565.48	449.59	242.86
620	24°48′	76°52.80′	292.30	65.04	517.30	243.62	571.80	460.52	250.15
630	25°12′	79°22.80′	295.89	67.95	519.36	253.41	577.88	471.84	257.83
640	25°36′	81°55.20′	299.39	70.92	520.98	263.28	583.73	483.61	265.92
650	26°00′	84°30.00′	302.81	73.96	522.16	273.20	589.32	495.86	274.47
660	26°24′	87°07.20′	306.14	77.05	522.90	283.18	594.65	508.65	283.54
670	26°48′	89°46.80′	309.38	80.20	523.17	293.17	599.71	522.04	293.17
680	27°12′	92°28.80′	312.52	83.41	522.97	303.17	604.49	536.10	303.45
690	27°36′	95°13.20′	315.57	86.67	522.30	313.15	608.98	550.91	314.45
700	28°00′	98°00.00′	318.51	89.97	521.15	323.08	613.17	566.55	326.25
710	28°24′	100°49.20′	321.36	93.33	519.51	332.94	617.05	583.15	338.97

THE STANDARD HIGHWAY SPIRAL

a = 4.5

L	D	S	q	p	Y	X	C	U	V
10	0°27′	0°01.35′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	0°54′	0°05.40′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°21′	0°12.15′	15.00	0.01	30.00	0.04	30.00	20.00	10.00
40	1°48′	0°21.60′	20.00	0.02	40.00	0.08	40.00	26.67	13.33
50	2°15′	0°33.75′	25.00	0.04	50.00	0.16	50.00	33.33	16.67
60	2°42′	0°48.60′	30.00	0.07	60.00	0.28	60.00	40.00	20.00
70	3°09′	1°06.15′	35.00	0.11	70.00	0.45	70.00	46.67	23.33
80	3°36′	1°26.40′	40.00	0.17	79.99	0.67	80.00	53.34	26.67
90	4°03′	1°49.35′	45.00	0.24	89.99	0.95	90.00	60.00	30.00
100	4°30′	2°15.00′	50.00	0.33	99.98	1.31	99.99	66.67	33.34
110	4°57′	2°43.35′	55.00	0.44	109.98	1.74	109.99	73.34	36.67
120	5°24′	3°14.40′	59.99	0.57	119.96	2.26	119.98	80.01	40.01
130	5°51′	3°48.15′	64.99	0.72	129.94	2.87	129.97	86.69	43.35
140	6°18′	4°24.60′	69.99	0.90	139.92	3.59	139.96	93.36	46.69
150	6°45′	5°03.75′	74.98	1.10	149.88	4.42	149.95	100.04	50.04
160	7°12′	5°45.60′	79.97	1.34	159.84	5.36	159.93	106.72	53.38
170	7°39′	6°30.15′	84.96	1.61	169.78	6.43	169.90	113.41	56.74
180	8°06′	7°17.40′	89.95	1.91	179.71	7.63	179.87	120.10	60.09
190	8°33′	8°07.35′	94.94	2.24	189.62	8.97	189.83	126.80	63.45
200	9°00′	9°00.00′	99.92	2.62	199.51	10.45	199.78	133.51	66.82
210	9°27′	9°55.35′	104.90	3.03	209.37	12.10	209.72	140.22	70.20
220	9°54′	10°53.40′	109.87	3.48	219.21	13.90	219.65	146.95	73.59
230	10°21′	11°54.15′	114.83	3.98	229.01	15.88	229.56	153.68	76.98
240	10°48′	12°57.60′	119.80	4.52	238.77	18.03	239.45	160.43	80.39
250	11°15′	14°03.75′	124.75	5.10	248.50	20.37	249.33	167.20	83.81
260	11°42′	15°12.60′	129.70	5.74	258.17	22.89	259.19	173.98	87.25
270	12°09′	16°24.15′	134.63	6.42	267.80	25.61	269.02	180.78	90.71
280	12°36′	17°38.40′	139.56	7.16	277.36	28.54	278.82	187.60	94.18
290	13°03′	18°55.35′	144.47	7.95	286.85	31.68	288.60	194.45	97.68
300	13°30′	20°15.00′	149.38	8.80	296.27	35.03	298.34	201.32	101.21
310	13°57′	21°37.35′	154.27	9.70	305.61	38.60	308.04	208.23	104.76
320	14°24′	23°02.40′	159.14	10.66	314.86	42.40	317.71	215.17	108.34
330	14°51′	24°30.15′	164.00	11.68	324.02	46.43	327.33	222.15	111.95
340	15°18′	26°00.60′	168.84	12.77	333.06	50.70	336.90	229.16	115.61
350	15°45′	27°33.75′	173.66	13.92	341.99	55.20	346.41	236.23	119.30
360	16°12′	29°09.60′	178.46	15.13	350.79	59.95	355.87	243.34	123.04
370	16°39′	30°48.15′	183.23	16.41	359.45	64.95	365.27	250.51	126.83
380	17°06′	32°29.40′	187.98	17.75	367.96	70.19	374.60	257.74	130.68
390	17°33′	34°13.35′	192.70	19.17	376.31	75.69	383.85	265.03	134.59
400	18°00′	36°00.00′	197.40	20.65	384.49	81.44	393.03	272.40	138.56
410	18°27′	37°49.35′	202.06	22.21	392.49	87.45	402.11	279.84	142.61
420	18°54′	39°41.40′	206.69	23.83	400.29	93.71	411.11	287.38	146.73
430	19°21′	41°36.15′	211.28	25.53	407.88	100.22	420.01	295.01	150.94
440	19°48′	43°33.60′	215.83	27.31	415.24	106.99	428.80	302.74	155.25
450	20°15′	45°33.75′	220.34	29.16	422.36	114.00	437.48	310.58	159.66
460	20°42′	47°36.60′	224.81	31.08	429.24	121.26	446.04	318.55	164.19
470	21°09′	49°42.15′	229.23	33.08	435.84	128.77	454.47	326.65	168.84
480	21°36′	51°50.40′	233.60	35.15	442.17	136.52	462.76	334.89	173.62
490	22°03′	54°01.35′	237.92	37.30	448.20	144.50	470.91	343.30	178.56
500	22°30′	56°15.00′	242.18	39.53	453.91	152.70	478.91	351.88	183.65

THE STANDARD HIGHWAY SPIRAL

a = 4.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	22°57′	58°31.35′	246.38	41.83	459.30	161.12	486.74	360.65	188.92
520	23°24′	60°50.40′	250.53	44.20	464.35	169.75	494.41	369.63	194.39
530	23°51′	63°12.15′	254.61	46.66	469.04	178.58	501.89	378.84	200.07
540	24°18′	65°36.60′	258.62	49.18	473.36	187.60	509.18	388.30	205.98
550	24°45′	68°03.75′	262.56	51.78	477.30	196.79	516.27	398.04	212.16
560	25°12′	70°33.60′	266.43	54.46	480.83	206.15	523.16	408.07	218.61
570	25°39′	73°06.15′	270.22	57.20	483.95	215.65	529.82	418.44	225.38
580	26°06′	75°41.40′	273.92	60.01	486.64	225.28	536.25	429.17	232.49
590	26°33′	78°19.35′	277.55	62.90	488.89	235.02	542.44	440.31	239.99
600	27°00′	81°00.00′	281.09	65.85	490.68	244.86	548.38	451.90	247.91
610	27°27′	83°43.35′	284.54	68.86	492.01	254.77	554.06	463.99	256.31
620	27°54′	86°29.40′	287.89	71.94	492.87	264.73	559.46	476.63	265.23
630	28°21′	89°18.15′	291.15	75.08	493.23	274.72	564.58	489.89	274.74
640	28°48′	92°09.60′	294.30	78.28	493.11	284.72	569.40	503.84	284.92
650	29°15′	95°03.75′	297.36	81.53	492.48	294.70	573.92	518.58	295.86
660	29°42′	98°00.60′	300.31	84.84	491.34	304.64	578.11	534.21	307.64
670	30°09′	101°00.15′	303.15	88.19	489.69	314.50	581.98	550.83	320.39

THE STANDARD HIGHWAY SPIRAL

a = 5.0

L	D	S	q	p	Y	X	C	U	V
10	0°30′	0°01.50′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°00′	0°06.00′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°30′	0°13.50′	15.00	0.01	30.00	0.04	30.00	20.00	10.00
40	2°00′	0°24.00′	20.00	0.02	40.00	0.09	40.00	26.67	13.33
50	2°30′	0°37.50′	25.00	0.05	50.00	0.18	50.00	33.33	16.67
60	3°00′	0°54.00′	30.00	0.08	60.00	0.31	60.00	40.00	20.00
70	3°30′	1°13.50′	35.00	0.12	70.00	0.50	70.00	46.67	23.33
80	4°00′	1°36.00′	40.00	0.19	79.99	0.74	80.00	53.34	26.67
90	4°30′	2°01.50′	45.00	0.27	89.99	1.06	90.00	60.00	30.00
100	5°00′	2°30.00′	50.00	0.36	99.98	1.45	99.99	66.67	33.34
110	5°30′	3°01.50′	54.99	0.48	109.97	1.94	109.99	73.34	36.68
120	6°00′	3°36.00′	59.99	0.63	119.95	2.51	119.98	80.02	40.02
130	6°30′	4°13.50′	64.99	0.80	129.93	3.19	129.97	86.69	43.36
140	7°00′	4°54.00′	69.98	1.00	139.90	3.99	139.95	93.37	46.70
150	7°30′	5°37.50′	74.98	1.23	149.86	4.91	149.94	100.05	50.05
160	8°00′	6°24.00′	79.97	1.49	159.80	5.95	159.91	106.74	53.40
170	8°30′	7°13.50′	84.95	1.79	169.73	7.14	169.88	113.43	56.75
180	9°00′	8°06.00′	89.94	2.12	179.64	8.47	179.84	120.13	60.11
190	9°30′	9°01.50′	94.92	2.49	189.53	9.96	189.79	126.83	63.48
200	10°00′	10°00.00′	99.90	2.91	199.39	11.61	199.73	133.55	66.86
210	10°30′	11°01.50′	104.87	3.36	209.22	13.43	209.65	140.27	70.25
220	11°00′	12°06.00′	109.84	3.87	219.02	15.44	219.56	147.01	73.65
230	11°30′	13°13.50′	114.80	4.42	228.78	17.63	229.46	153.76	77.06
240	12°00′	14°24.00′	119.75	5.02	238.49	20.02	239.33	160.53	80.48
250	12°30′	15°37.50′	124.69	5.67	248.15	22.61	249.17	167.32	83.93
260	13°00′	16°54.00′	129.62	6.37	257.75	25.40	259.00	174.13	87.39
270	13°30′	18°13.50′	134.55	7.13	267.28	28.42	268.79	180.96	90.88
280	14°00′	19°36.00′	139.46	7.95	276.74	31.66	278.55	187.82	94.39
290	14°30′	21°01.50′	144.35	8.83	286.12	35.13	288.27	194.71	97.92
300	15°00′	22°30.00′	149.23	9.76	295.41	38.84	297.95	201.64	101.49
310	15°30′	24°01.50′	154.10	10.76	304.59	42.79	307.58	208.60	105.10
320	16°00′	25°36.00′	158.94	11.83	313.67	46.98	317.17	215.61	108.74
330	16°30′	27°13.50′	163.77	12.96	322.63	51.43	326.70	222.66	112.42
340	17°00′	28°54.00′	168.57	14.16	331.45	56.13	336.17	229.76	116.15
350	17°30′	30°37.50′	173.35	15.43	340.13	61.10	345.58	236.92	119.94
360	18°00′	32°24.00′	178.10	16.77	348.66	66.32	354.91	244.15	123.78
370	18°30′	34°13.50′	182.82	18.19	357.01	71.82	364.17	251.44	127.68
380	19°00′	36°06.00′	187.51	19.67	365.19	77.57	373.34	258.81	131.66
390	19°30′	38°01.50′	192.17	21.23	373.17	83.60	382.42	266.26	135.71
400	20°00′	40°00.00′	196.79	22.87	380.94	89.89	391.40	273.81	139.85
410	20°30′	42°01.50′	201.38	24.58	388.49	96.45	400.28	281.46	144.08
420	21°00′	44°06.00′	205.92	26.38	395.79	103.28	409.05	289.21	148.41
430	21°30′	46°13.50′	210.42	28.25	402.84	110.37	417.69	297.09	152.86
440	22°00′	48°24.00′	214.87	30.20	409.62	117.72	426.20	305.10	157.42
450	22°30′	50°37.50′	219.27	32.23	416.12	125.33	434.58	313.26	162.13
460	23°00′	52°54.00′	223.62	34.33	422.30	133.18	442.81	321.58	166.98
470	23°30′	55°13.50′	227.91	36.52	428.17	141.28	450.88	330.08	171.99
480	24°00′	57°36.00′	232.14	38.79	433.71	149.60	458.78	338.76	177.19
490	24°30′	60°01.50′	236.31	41.14	438.89	158.16	466.51	347.66	182.58
500	25°00′	62°30.00′	240.41	43.57	443.69	166.93	474.05	356.80	188.19

THE STANDARD HIGHWAY SPIRAL

a = 5.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	25°30′	65°01.50′	244.44	46.07	448.11	175.89	481.40	366.19	194.04
520	26°00′	67°36.00′	248.39	48.66	452.13	185.05	488.54	375.86	200.15
530	26°30′	70°13.50′	252.27	51.32	455.73	194.38	495.45	385.85	206.56
540	27°00′	72°54.00′	256.07	54.06	458.89	203.87	502.14	396.18	213.29
550	27°30′	75°37.50′	259.78	56.87	461.61	213.49	508.58	406.89	220.39
560	28°00′	78°24.00′	263.41	59.75	463.85	223.23	514.78	418.03	227.89
570	28°30′	81°13.50′	266.94	62.71	465.62	233.07	520.70	429.65	235.83
580	29°00′	84°06.00′	270.38	65.73	466.90	242.99	526.35	441.79	244.29
590	29°30′	87°01.50′	273.71	68.82	467.68	252.96	531.70	454.53	253.30
600	30°00′	90°00.00′	276.95	71.97	467.94	262.96	536.76	467.94	262.96
610	30°30′	93°01.50′	280.08	75.18	467.67	272.95	541.50	482.10	273.33
620	31°00′	96°06.00′	283.10	78.45	466.88	282.92	545.91	497.11	284.53
630	31°30′	99°13.50′	286.01	81.78	465.55	292.83	549.98	513.10	296.66
640	32°00′	102°24.00′	288.80	85.15	463.67	302.65	553.70	530.21	309.88

THE STANDARD HIGHWAY SPIRAL

a = 5.5

L	D	S	q	p	Y	X	C	U	V
10	0°33′	0°01.65′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°06′	0°06.60′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°39′	0°14.85′	15.00	0.01	30.00	0.04	30.00	20.00	10.00
40	2°12′	0°26.40′	20.00	0.03	40.00	0.10	40.00	26.67	13.33
50	2°45′	0°41.25′	25.00	0.05	50.00	0.20	50.00	33.33	16.67
60	3°18′	0°59.40′	30.00	0.09	60.00	0.35	60.00	40.00	20.00
70	3°51′	1°20.85′	35.00	0.14	70.00	0.55	70.00	46.67	23.33
80	4°24′	1°45.60′	40.00	0.20	79.99	0.82	80.00	53.34	26.67
90	4°57′	2°13.65′	45.00	0.29	89.99	1.17	89.99	60.00	30.00
100	5°30′	2°45.00′	50.00	0.40	99.98	1.60	99.99	66.67	33.34
110	6°03′	3°19.65′	54.99	0.53	109.96	2.13	109.98	73.35	36.68
120	6°36′	3°57.60′	59.99	0.69	119.94	2.76	119.97	80.02	40.02
130	7°09′	4°38.85′	64.99	0.88	129.91	3.51	129.96	86.70	43.36
140	7°42′	5°23.40′	69.98	1.10	139.88	4.39	139.94	93.38	46.71
150	8°15′	6°11.25′	74.97	1.35	149.83	5.40	149.92	100.06	50.06
160	8°48′	7°02.40′	79.96	1.64	159.76	6.55	159.89	106.75	53.41
170	9°21′	7°56.85′	84.95	1.96	169.67	7.85	169.85	113.45	56.77
180	9°54′	8°54.60′	89.93	2.33	179.57	9.31	179.81	120.15	60.14
190	10°27′	9°55.65′	94.91	2.74	189.43	10.95	189.75	126.87	63.51
200	11°00′	11°00.00′	99.88	3.20	199.26	12.77	199.67	133.59	66.90
210	11°33′	12°07.65′	104.84	3.70	209.06	14.77	209.58	140.33	70.30
220	12°06′	13°18.60′	109.80	4.25	218.82	16.97	219.47	147.08	73.71
230	12°39′	14°32.85′	114.75	4.86	228.52	19.38	229.34	153.85	77.14
240	13°12′	15°50.40′	119.69	5.51	238.17	22.00	239.19	160.65	80.59
250	13°45′	17°11.25′	124.63	6.23	247.76	24.84	249.00	167.46	84.05
260	14°18′	18°35.40′	129.55	7.00	257.28	27.91	258.79	174.30	87.55
270	14°51′	20°02.85′	134.45	7.84	266.71	31.22	268.53	181.17	91.06
280	15°24′	21°33.60′	139.34	8.74	276.06	34.77	278.24	188.07	94.61
290	15°57′	23°07.65′	144.22	9.70	285.31	38.57	287.91	195.01	98.19
300	16°30′	24°45.00′	149.07	10.73	294.45	42.62	297.52	201.99	101.81
310	17°03′	26°25.65′	153.91	11.83	303.47	46.94	307.08	209.02	105.47
320	17°36′	28°09.60′	158.72	12.99	312.36	51.53	316.58	216.10	109.18
330	18°09′	29°56.85′	163.51	14.23	321.10	56.38	326.01	223.23	112.94
340	18°42′	31°47.40′	168.27	15.55	329.68	61.51	335.37	230.43	116.76
350	19°15′	33°41.25′	173.00	16.94	338.09	66.92	344.65	237.70	120.65
360	19°48′	35°38.40′	177.70	18.41	346.32	72.61	353.85	245.05	124.61
370	20°21′	37°38.85′	182.37	19.95	354.34	78.57	362.95	252.49	128.64
380	20°54′	39°42.60′	187.00	21.57	362.15	84.82	371.95	260.02	132.76
390	21°27′	41°49.65′	191.59	23.28	369.72	91.35	380.84	267.65	136.98
400	22°00′	44°00.00′	196.13	25.07	377.05	98.16	389.61	275.40	141.31
410	22°33′	46°13.65′	200.63	26.93	384.10	105.24	398.26	283.27	145.75
420	23°06′	48°30.60′	205.08	28.89	390.88	112.60	406.77	291.29	150.32
430	23°39′	50°50.85′	209.48	30.92	397.35	120.22	415.14	299.46	155.03
440	24°12′	53°14.40′	213.82	33.04	403.50	128.11	423.35	307.80	159.90
450	24°45′	55°41.25′	218.10	35.24	409.31	136.24	431.39	316.33	164.95
460	25°18′	58°11.40′	222.31	37.53	414.77	144.62	439.26	325.06	170.18
470	25°51′	60°44.85′	226.46	39.90	419.85	153.24	446.94	334.02	175.63
480	26°24′	63°21.60′	230.54	42.35	424.53	162.07	454.42	343.23	181.32
490	26°57′	66°01.65′	234.55	44.89	428.81	171.11	461.69	352.72	187.26
500	27°30′	68°45.00′	238.47	47.50	432.65	180.34	468.73	362.52	193.49

THE STANDARD HIGHWAY SPIRAL

a = 5.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	28°03′	71°31.65′	242.31	50.20	436.05	189.74	475.54	372.67	200.05
520	28°36′	74°21.60′	246.07	52.97	438.98	199.30	482.11	383.19	206.96
530	29°09′	77°14.85′	249.73	55.83	441.44	208.99	488.41	394.14	214.28
540	29°42′	80°11.40′	253.30	58.75	443.39	218.80	494.44	405.56	222.05
550	30°15′	83°11.25′	256.77	61.75	444.84	228.69	500.18	417.52	230.32
560	30°48′	86°14.40′	260.14	64.82	445.76	238.65	505.63	430.08	239.16
570	31°21′	89°20.85′	263.40	67.96	446.15	248.64	510.75	443.32	248.66
580	31°54′	92°30.60′	266.55	71.16	445.99	258.64	515.56	457.32	258.89
590	32°27′	95°43.65′	269.58	74.42	445.27	268.61	520.02	472.21	269.96
600	33°00′	99°00.00′	272.50	77.74	443.99	278.53	524.12	488.10	282.00
610	33°33′	102°19.65′	275.30	81.12	442.14	288.35	527.86	505.16	295.16

THE STANDARD HIGHWAY SPIRAL

$a = 6.0$

L	D	S	q	p	Y	X	C	U	V
10	0°36′	0°01.80′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°12′	0°07.20′	10.00	0.00	20.00	0.01	20.00	13.33	6.67
30	1°48′	0°16.20′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2°24′	0°28.80′	20.00	0.03	40.00	0.11	40.00	26.67	13.33
50	3°00′	0°45.00′	25.00	0.05	50.00	0.22	50.00	33.33	16.67
60	3°36′	1°04.80′	30.00	0.09	60.00	0.38	60.00	40.00	20.00
70	4°12′	1°28.20′	35.00	0.15	70.00	0.60	70.00	46.67	23.33
80	4°48′	1°55.20′	40.00	0.22	79.99	0.89	80.00	53.34	26.67
90	5°24′	2°25.80′	45.00	0.32	89.98	1.27	89.99	60.01	30.01
100	6°00′	3°00.00′	50.00	0.44	99.97	1.74	99.99	66.68	33.34
110	6°36′	3°37.80′	54.99	0.58	109.96	2.32	109.98	73.35	36.68
120	7°12′	4°19.20′	59.99	0.75	119.93	3.01	119.97	80.02	40.02
130	7°48′	5°04.20′	64.98	0.96	129.90	3.83	129.95	86.70	43.37
140	8°24′	5°52.80′	69.98	1.20	139.85	4.79	139.93	93.38	46.71
150	9°00′	6°45.00′	74.97	1.47	149.79	5.88	149.91	100.07	50.07
160	9°36′	7°40.80′	79.95	1.79	159.71	7.14	159.87	106.77	53.42
170	10°12′	8°40.20′	84.94	2.14	169.61	8.56	169.83	113.47	56.79
180	10°48′	9°43.20′	89.91	2.54	179.48	10.16	179.77	120.18	60.16
190	11°24′	10°49.80′	94.89	2.99	189.32	11.94	189.70	126.90	63.55
200	12°00′	12°00.00′	99.85	3.49	199.12	13.92	199.61	133.64	66.95
210	12°36′	13°13.80′	104.81	4.03	208.88	16.10	209.50	140.39	70.36
220	13°12′	14°31.20′	109.76	4.64	218.59	18.50	219.37	147.16	73.78
230	13°48′	15°52.20′	114.71	5.29	228.24	21.12	229.22	153.95	77.23
240	14°24′	17°16.80′	119.64	6.01	237.83	23.97	239.03	160.77	80.70
250	15°00′	18°45.00′	124.56	6.79	247.34	27.06	248.81	167.61	84.19
260	15°36′	20°16.80′	129.46	7.63	256.76	30.40	258.56	174.48	87.71
270	16°12′	21°52.20′	134.35	8.54	266.09	34.00	268.26	181.39	91.27
280	16°48′	23°31.20′	139.22	9.52	275.32	37.85	277.91	188.34	94.86
290	17°24′	25°13.80′	144.07	10.57	284.43	41.98	287.51	195.33	98.49
300	18°00′	27°00.00′	148.90	11.69	293.41	46.38	297.05	202.38	102.16
310	18°36′	28°49.80′	153.70	12.88	302.24	51.06	306.53	209.48	105.89
320	19°12′	30°43.20′	158.48	14.15	310.92	56.03	315.93	216.64	109.68
330	19°48′	32°40.20′	163.23	15.50	319.43	61.28	325.26	223.87	113.52
340	20°24′	34°40.80′	167.94	16.93	327.75	66.82	334.50	231.17	117.44
350	21°00′	36°45.00′	172.63	18.44	335.87	72.66	343.64	238.57	121.44
360	21°36′	38°52.80′	177.27	20.03	343.77	78.79	352.69	246.06	125.52
370	22°12′	41°04.20′	181.88	21.70	351.44	85.21	361.62	253.65	129.71
380	22°48′	43°19.20′	186.44	23.46	358.84	91.93	370.43	261.36	133.99
390	23°24′	45°37.80′	190.95	25.30	365.98	98.93	379.12	269.20	138.40
400	24°00′	48°00.00′	195.41	27.24	372.82	106.22	387.66	277.18	142.94
410	24°36′	50°25.80′	199.82	29.25	379.36	113.80	396.06	285.32	147.62
420	25°12′	52°55.20′	204.17	31.36	385.56	121.64	404.29	293.63	152.47
430	25°48′	55°28.20′	208.46	33.55	391.41	129.75	412.35	302.13	157.49
440	26°24′	58°04.80′	212.68	35.83	396.89	138.11	420.23	310.85	162.72
450	27°00′	60°45.00′	216.83	38.20	401.98	146.72	427.92	319.81	168.16
460	27°36′	63°28.80′	220.90	40.66	406.65	155.56	435.39	329.03	173.85
470	28°12′	66°16.20′	224.90	43.20	410.90	164.61	442.65	338.54	179.81
480	28°48′	69°07.20′	228.82	45.82	414.70	173.86	449.67	348.37	186.08
490	29°24′	72°01.80′	232.65	48.53	418.02	183.29	456.44	358.57	192.69
500	30°00′	75°00.00′	236.38	51.32	420.86	192.88	462.95	369.18	199.68

THE STANDARD HIGHWAY SPIRAL

a = 6.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	30°36′	78°01.80′	240.02	54.19	423.19	202.60	469.19	380.24	207.10
520	31°12′	81°07.20′	243.56	57.14	425.00	212.43	475.14	391.81	215.01
530	31°48′	84°16.20′	247.00	60.17	426.27	222.35	480.78	403.96	223.47
540	32°24′	87°28.80′	250.33	63.26	426.99	232.32	486.11	416.77	232.55
550	33°00′	90°45.00′	253.54	66.43	427.15	242.32	491.10	430.32	242.34
560	33°36′	94°04.80′	256.64	69.66	426.73	252.31	495.74	444.73	252.95
570	34°12′	97°28.20′	259.61	72.95	425.72	262.26	500.02	460.11	264.50
580	34°48′	100°55.20′	262.47	76.30	424.13	272.13	503.92	476.63	277.15

THE STANDARD HIGHWAY SPIRAL

$a = 6.5$

L	D	S	q	p	Y	X	C	U	V
10	0°39′	0°01.95′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°18′	0°07.80′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	1°57′	0°17.55′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2°36′	0°31.20′	20.00	0.03	40.00	0.12	40.00	26.67	13.33
50	3°15′	0°48.75′	25.00	0.06	50.00	0.24	50.00	33.33	16.67
60	3°54′	1°10.20′	30.00	0.10	60.00	0.41	60.00	40.00	20.00
70	4°33′	1°35.55′	35.00	0.16	69.99	0.65	70.00	46.67	23.34
80	5°12′	2°04.80′	40.00	0.24	79.99	0.97	80.00	53.34	26.67
90	5°51′	2°37.95′	45.00	0.34	89.98	1.38	89.99	60.01	30.01
100	6°30′	3°15.00′	49.99	0.47	99.97	1.89	99.99	66.68	33.34
110	7°09′	3°55.95′	54.99	0.63	109.95	2.52	109.98	73.35	36.68
120	7°48′	4°40.80′	59.99	0.82	119.92	3.27	119.96	80.03	40.03
130	8°27′	5°29.55′	64.98	1.04	129.88	4.15	129.95	86.71	43.37
140	9°06′	6°22.20′	69.97	1.30	139.83	5.18	139.92	93.39	46.72
150	9°45′	7°18.75′	74.96	1.59	149.76	6.37	149.89	100.09	50.08
160	10°24′	8°19.20′	79.94	1.93	159.66	7.73	159.85	106.78	53.44
170	11°03′	9°23.55′	84.92	2.32	169.54	9.27	169.80	113.49	56.81
180	11°42′	10°31.80′	89.90	2.75	179.39	11.00	179.73	120.21	60.19
190	12°21′	11°43.95′	94.87	3.24	189.20	12.93	189.65	126.95	63.59
200	13°00′	13°00.00′	99.83	3.77	198.97	15.07	199.54	133.69	67.00
210	13°39′	14°19.95′	104.78	4.37	208.69	17.43	209.42	140.46	70.42
220	14°18′	15°43.80′	109.72	5.02	218.35	20.02	219.26	147.25	73.86
230	14°57′	17°11.55′	114.66	5.73	227.94	22.86	229.08	154.06	77.33
240	15°36′	18°43.20′	119.57	6.51	237.45	25.94	238.86	160.90	80.82
250	16°15′	20°18.75′	124.48	7.35	246.88	29.28	248.61	167.78	84.34
260	16°54′	21°58.20′	129.37	8.26	256.20	32.88	258.30	174.69	87.90
270	17°33′	23°41.55′	134.23	9.25	265.42	36.76	267.95	181.64	91.49
280	18°12′	25°28.80′	139.08	10.30	274.51	40.92	277.55	188.64	95.13
290	18°51′	27°19.95′	143.91	11.44	283.47	45.37	287.08	195.69	98.81
300	19°30′	29°15.00′	148.71	12.64	292.28	50.11	296.54	202.80	102.55
310	20°09′	31°13.95′	153.48	13.93	300.91	55.14	305.93	209.98	106.35
320	20°48′	33°16.80′	158.22	15.30	309.37	60.48	315.23	217.23	110.22
330	21°27′	35°23.55′	162.92	16.76	317.63	66.12	324.44	224.56	114.16
340	22°06′	37°34.20′	167.59	18.30	325.67	72.06	333.55	231.99	118.19
350	22°45′	39°48.75′	172.22	19.92	333.47	78.31	342.55	239.52	122.31
360	23°24′	42°07.20′	176.81	21.63	341.03	84.87	351.43	247.17	126.54
370	24°03′	44°29.55′	181.34	23.43	348.30	91.73	360.18	254.94	130.89
380	24°42′	46°55.80′	185.83	25.32	355.29	98.88	368.79	262.85	135.36
390	25°21′	49°25.95′	190.26	27.31	361.95	106.33	377.25	270.92	139.98
400	26°00′	52°00.00′	194.63	29.38	368.29	114.07	385.55	279.16	144.76
410	26°39′	54°37.95′	198.94	31.54	374.26	122.09	393.67	287.60	149.72
420	27°18′	57°19.80′	203.18	33.79	379.85	130.38	401.61	296.25	154.88
430	27°57′	60°05.55′	207.35	36.14	385.05	138.92	409.34	305.14	160.27
440	28°36′	62°55.20′	211.45	38.58	389.82	147.71	416.87	314.30	165.90
450	29°15′	65°48.75′	215.46	41.10	394.15	156.73	424.16	323.75	171.81
460	29°54′	68°46.20′	219.39	43.71	398.01	165.95	431.22	333.54	178.03
470	30°33′	71°47.55′	223.22	46.41	401.38	175.36	438.02	343.70	184.60
480	31°12′	74°52.80′	226.97	49.20	404.25	184.94	444.54	354.28	191.57
490	31°51′	78°01.95′	230.61	52.07	406.59	194.66	450.79	365.33	198.98
500	32°30′	81°15.00′	234.15	55.02	408.39	204.50	456.73	376.92	206.90

THE STANDARD HIGHWAY SPIRAL

a = 6.5—Continued

L	D	S	q	p	Y	X	C	U	V
510	33°09′	84°31.95′	227.58	58.05	409.63	214.42	462.35	389.11	215.40
520	33°48′	87°52.80′	240.89	61.15	410.29	224.39	467.64	401.98	224.56
530	34°27′	91°17.55′	244.09	64.32	410.36	234.39	472.59	415.65	234.45
540	35°06′	94°46.20′	247.17	67.57	409.84	244.38	477.16	430.23	245.23
550	35°45′	98°18.75′	250.11	70.87	408.70	254.31	481.36	445.86	257.01
560	36°24′	101°55.20′	252.93	74.24	406.94	264.15	485.16	462.71	269.97

THE STANDARD HIGHWAY SPIRAL

a = 7.0

L	D	S	q	p	Y	X	C	U	V
10	0°42′	0°02.10′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°24′	0°08.40′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	2°06′	0°18.90′	15.00	0.01	30.00	0.05	30.00	20.00	10.00
40	2°48′	0°33.60′	20.00	0.03	40.00	0.13	40.00	26.67	13.33
50	3°30′	0°52.50′	25.00	0.06	50.00	0.25	50.00	33.33	16.67
60	4°12′	1°15.60′	30.00	0.11	60.00	0.44	60.00	40.00	20.00
70	4°54′	1°42.90′	35.00	0.17	69.99	0.70	70.00	46.67	23.34
80	5°36′	2°14.40′	40.00	0.26	79.99	1.04	79.99	53.34	26.67
90	6°18′	2°50.10′	45.00	0.37	89.98	1.48	89.99	60.01	30.01
100	7°00′	3°30.00′	49.99	0.51	99.96	2.04	99.98	66.68	33.35
110	7°42′	4°14.10′	54.99	0.68	109.94	2.71	109.97	73.35	36.69
120	8°24′	5°02.40′	59.98	0.88	119.91	3.52	119.96	80.03	40.03
130	9°06′	5°54.90′	64.98	1.12	129.86	4.47	129.94	86.72	43.38
140	9°48′	6°51.60′	69.97	1.40	139.80	5.58	139.91	93.40	46.73
150	10°30′	7°52.50′	74.95	1.72	149.72	6.86	149.87	100.10	50.09
160	11°12′	8°57.60′	79.93	2.08	159.61	8.33	159.83	106.80	53.46
170	11°54′	10°06.90′	84.91	2.50	169.47	9.98	169.76	113.52	56.84
180	12°36′	11°20.40′	89.88	2.96	179.30	11.84	179.69	120.25	60.22
190	13°18′	12°38.10′	94.85	3.49	189.08	13.92	189.59	126.99	63.63
200	14°00′	14°00.00′	99.80	4.06	198.81	16.22	199.47	133.75	67.05
210	14°42′	15°26.10′	104.75	4.70	208.48	18.76	209.32	140.54	70.49
220	15°24′	16°56.40′	109.68	5.40	218.08	21.55	219.15	147.34	73.95
230	16°06′	18°30.90′	114.60	6.17	227.61	24.59	228.93	154.18	77.44
240	16°48′	20°09.60′	119.51	7.01	237.05	27.90	238.68	161.05	80.96
250	17°30′	21°52.50′	124.40	7.91	246.38	31.49	248.38	167.96	84.51
260	18°12′	23°39.60′	129.26	8.89	255.60	35.35	258.03	174.91	88.10
270	18°54′	25°30.90′	134.11	9.95	264.69	39.51	267.63	181.91	91.74
280	19°36′	27°26.40′	138.94	11.08	273.65	43.97	277.16	188.96	95.42
290	20°18′	29°26.10′	143.73	12.30	282.44	48.73	286.61	196.08	99.16
300	21°00′	31°30.00′	148.50	13.60	291.06	53.80	295.99	203.26	102.97
310	21°42′	33°38.10′	153.24	14.98	299.49	59.18	305.28	210.52	106.85
320	22°24′	35°50.40′	157.94	16.45	307.70	64.88	314.47	217.88	110.81
330	23°06′	38°06.90′	162.60	18.01	315.69	70.89	323.56	225.33	114.86
340	23°48′	40°27.60′	167.21	19.66	323.43	77.23	332.52	232.88	119.01
350	24°30′	42°52.50′	171.78	21.39	330.90	83.87	341.37	240.57	123.27
360	25°12′	45°21.60′	176.30	23.23	338.08	90.83	350.07	248.38	127.66
370	25°54′	47°54.90′	180.77	25.15	344.95	98.10	358.63	256.35	132.19
380	26°36′	50°32.40′	185.18	27.17	351.48	105.67	367.02	264.49	136.87
390	27°18′	53°14.10′	189.52	29.28	357.65	113.54	375.24	272.82	141.73
400	28°00′	56°00.00′	193.80	31.49	363.44	121.69	383.27	281.36	146.79
410	28°42′	58°50.10′	198.00	33.79	368.83	130.12	391.11	290.13	152.06
420	29°24′	61°44.40′	202.13	36.19	373.78	138.80	398.72	299.17	157.58
430	30°06′	64°42.90′	206.17	38.68	378.29	147.73	406.11	308.51	163.38
440	30°48′	67°45.60′	210.13	41.26	382.32	156.88	413.25	318.17	169.49
450	31°30′	70°52.50′	214.00	43.93	385.85	166.23	420.14	328.21	175.94
460	32°12′	74°03.60′	217.77	46.70	388.86	175.77	426.74	338.66	182.79
470	32°54′	77°18.90′	221.44	49.54	391.34	185.45	433.06	349.59	190.09
480	33°36′	80°38.40′	225.00	52.48	393.25	195.27	439.06	361.06	197.90
490	34°18′	84°02.10′	228.45	55.49	394.58	205.18	444.74	373.15	206.29
500	35°00′	87°30.00′	231.78	58.59	395.32	215.15	450.06	385.93	215.35

THE STANDARD HIGHWAY SPIRAL
a = 7.0—Continued

L	D	S	q	p	Y	X	C	U	V
510	35°42′	91°02.10′	234.99	61.75	395.45	225.15	455.05	399.52	225.18
520	36°24′	94°38.40′	238.07	64.99	394.96	235.13	459.65	414.04	235.90
530	37°06′	98°18.90′	241.02	68.30	393.83	245.07	463.85	429.65	247.67
540	37°48′	102°03.60′	243.83	71.66	392.06	254.91	467.64	446.52	260.66

THE STANDARD HIGHWAY SPIRAL

a = 8.0

L	D	S	q	p	Y	X	C	U	V
10	0°48′	0°02.40′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°36′	0°09.60′	10.00	0.00	20.00	0.02	20.00	13.33	6.67
30	2°24′	0°21.60′	15.00	0.02	30.00	0.06	30.00	20.00	10.00
40	3°12′	0°38.40′	20.00	0.04	40.00	0.15	40.00	26.67	13.33
50	4°00′	1°00.00′	25.00	0.07	50.00	0.29	50.00	33.33	16.67
60	4°48′	1°26.40′	30.00	0.13	60.00	0.50	60.00	40.00	20.00
70	5°36′	1°57.60′	35.00	0.20	69.99	0.80	70.00	46.67	23.34
80	6°24′	2°33.60′	40.00	0.30	79.98	1.19	79.99	53.34	26.67
90	7°12′	3°14.40′	45.00	0.42	89.97	1.70	89.99	60.01	30.01
100	8°00′	4°00.00′	49.99	0.58	99.95	2.33	99.98	66.68	33.35
110	8°48′	4°50.40′	54.99	0.77	109.92	3.10	109.97	73.36	36.69
120	9°36′	5°45.60′	59.98	1.00	119.88	4.02	119.95	80.04	40.04
130	10°24′	6°45.60′	64.97	1.28	129.82	5.11	129.92	86.73	43.39
140	11°12′	7°50.40′	69.96	1.60	139.74	6.38	139.88	93.43	46.75
150	12°00′	9°00.00′	74.94	1.96	149.63	7.84	149.84	100.13	50.12
160	12°48′	10°14.40′	79.91	2.38	159.49	9.51	159.77	106.85	53.50
170	13°36′	11°33.60′	84.88	2.85	169.31	11.40	169.69	113.58	56.89
180	14°24′	12°57.60′	89.85	3.39	179.08	13.52	179.59	120.32	60.29
190	15°12′	14°26.40′	94.80	3.98	188.80	15.89	189.46	127.09	63.72
200	16°00′	16°00.00′	99.74	4.64	198.45	18.51	199.31	133.88	67.17
210	16°48′	17°38.40′	104.67	5.37	208.02	21.41	209.12	140.70	70.64
220	17°36′	19°21.60′	109.58	6.17	217.50	24.58	218.89	147.55	74.14
230	18°24′	21°09.60′	114.48	7.04	226.88	28.04	228.61	154.44	77.68
240	19°12′	23°02.40′	119.36	8.00	236.15	31.80	238.28	161.38	81.25
250	20°00′	25°00.00′	124.21	9.03	245.28	35.87	247.89	168.36	84.87
260	20°48′	27°02.40′	129.04	10.14	254.27	40.26	257.44	175.40	88.55
270	21°36′	29°09.60′	133.84	11.35	263.09	44.96	266.90	182.50	92.28
280	22°24′	31°21.60′	138.61	12.64	271.73	50.00	276.29	189.68	96.08
290	23°12′	33°38.40′	143.35	14.02	280.16	55.37	285.58	196.94	99.96
300	24°00′	36°00.00′	148.05	15.49	288.37	61.08	294.77	204.30	103.92
310	24°48′	38°26.40′	152.70	17.06	296.33	67.13	303.84	211.76	107.98
320	25°36′	40°57.60′	157.31	18.72	304.03	73.52	312.79	219.34	112.15
330	26°24′	43°33.60′	161.87	20.48	311.43	80.24	321.60	227.05	116.44
340	27°12′	46°14.40′	166.38	22.34	318.51	87.30	330.26	234.92	120.87
350	28°00′	49°00.00′	170.82	24.30	325.25	94.68	338.75	242.95	125.45
360	28°48′	51°50.40′	175.20	26.36	331.63	102.39	347.07	251.17	130.22
370	29°36′	54°45.60′	179.51	28.53	337.60	110.40	355.20	259.61	135.18
380	30°24′	57°45.60′	183.74	30.79	343.16	118.72	363.11	268.28	140.36
390	31°12′	60°50.40′	187.90	33.15	348.26	127.31	370.80	277.23	145.79
400	32°00′	64°00.00′	191.96	35.62	352.89	136.18	378.26	286.47	151.51
410	32°48′	67°14.40′	195.94	38.18	357.02	145.28	385.45	296.07	157.55
420	33°36′	70°33.60′	199.82	40.84	360.62	154.61	392.37	306.05	163.96
430	34°24′	73°57.60′	203.60	43.60	363.67	164.13	398.99	316.48	170.78
440	35°12′	77°26.40′	207.26	46.45	366.14	173.82	405.31	327.41	178.08
450	36°00′	81°00.00′	210.82	49.39	368.01	183.64	411.29	338.92	185.93
460	36°48′	84°38.40′	214.25	52.41	369.26	193.56	416.92	351.10	194.41
470	37°36′	88°21.60′	217.55	55.52	369.87	203.54	422.18	364.05	203.63
480	38°24′	92°09.60′	220.73	58.71	369.83	213.54	427.05	377.88	213.69
490	39°12′	96°02.40′	223.76	61.97	369.12	223.51	431.51	392.77	224.76
500	40°00′	100°00.00′	226.66	65.30	367.72	233.41	435.55	408.88	237.02

THE STANDARD HIGHWAY SPIRAL

a = 9.0

L	D	S	q	p	Y	X	C	U	V
10	0°54′	0°02.70′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	1°48′	0°10.80′	10.00	0.01	20.00	0.02	20.00	13.33	6.67
30	2°42′	0°24.30′	15.00	0.02	30.00	0.07	30.00	20.00	10.00
40	3°36′	0°43.20′	20.00	0.04	40.00	0.17	40.00	26.67	13.33
50	4°30′	1°07.50′	25.00	0.08	50.00	0.33	50.00	33.33	16.67
60	5°24′	1°37.20′	30.00	0.14	60.00	0.57	60.00	40.00	20.00
70	6°18′	2°12.30′	35.00	0.22	69.99	0.90	70.00	46.67	23.34
80	7°12′	2°52.80′	40.00	0.34	79.98	1.34	79.99	53.34	26.67
90	8°06′	3°38.70′	44.99	0.48	89.96	1.91	89.98	60.01	30.01
100	9°00′	4°30.00′	49.99	0.65	99.94	2.62	99.97	66.69	33.35
110	9°54′	5°26.70′	54.98	0.87	109.90	3.48	109.96	73.37	36.70
120	10°48′	6°28.80′	59.97	1.13	119.85	4.52	119.93	80.05	40.05
130	11°42′	7°36.30′	64.96	1.44	129.77	5.74	129.90	86.75	43.41
140	12°36′	8°49.20′	69.94	1.79	139.67	7.17	139.85	93.45	46.77
150	13°30′	10°07.50′	74.92	2.21	149.53	8.82	149.79	100.16	50.15
160	14°24′	11°31.20′	79.89	2.68	159.35	10.69	159.71	106.89	53.54
170	15°18′	13°00.30′	84.85	3.21	169.13	12.81	169.61	113.64	56.95
180	16°12′	14°34.80′	89.81	3.81	178.84	15.20	179.48	120.41	60.37
190	17°06′	16°14.70′	94 75	4.48	188.48	17.85	189.32	127.20	63.82
200	18°00′	18°00.00′	99.67	5.22	198.04	20.80	199.12	134.03	67.30
210	18°54′	19°50.70′	104.58	6.04	207.49	24.04	208.88	140.89	70.81
220	19°48′	21°46.80′	109.47	6.93	216.84	27.59	218.59	147.79	74.36
230	20°42′	23°48.30′	114.34	7.91	226.06	31.46	228.24	154.74	77.95
240	21°36′	25°55.20′	119.19	8.98	235.13	35.67	237.82	161.75	81.59
250	22°30′	28°07.50′	124.00	10.14	244.04	40.21	247.33	168.82	85.29
260	23°24′	30°25.20′	128.79	11.39	252.77	45.10	256.76	175.96	89.06
270	24°18′	32°48.30′	133.54	12.73	261.28	50.34	266.09	183.19	92.91
280	25°12′	35°16.80′	138.25	14.17	269.57	55.93	275.31	190.51	96.84
290	26°06′	37°50.70′	142.92	15.72	277.60	61.89	284.42	197.94	100.87
300	27°00′	40°30.00′	147.54	17.36	285.35	68.20	293.39	205.50	105.02
310	27°54′	43°14.70′	152.10	19.11	292.80	74.88	302.22	213.19	109.29
320	28°48′	46°04.80′	156.61	20.96	299.91	81.90	310.90	221.04	113.71
330	29°42′	49°00.30′	161.06	22.92	306.66	89.28	319.40	229.07	118.29
340	30°36′	52°01.20′	165.43	24.98	313.02	97.00	327.71	237.30	123.06
350	31°30′	55°07.50′	169.74	27.15	318.96	105.04	335.81	245.75	128.03
360	32°24′	58°19.20′	173.96	29.43	324.45	113.40	343.69	254.47	133.25
370	33°18′	61°36.30′	178.10	31.82	329.45	122.05	351.34	263.47	138.75
380	34°12′	64°58.80′	182.14	34.31	333.95	130.98	358.72	272.81	144.55
390	35°06′	68°26.70′	186.08	36.90	337.90	140.17	365.82	282.53	150.71
400	36°00′	72°00.00′	189.92	39.60	341.29	149.58	372.63	292.69	157.27
410	36°54′	75°38.70′	193.65	42.40	344.07	159.18	379.11	303.34	164.31
420	37°43′	79°22.80′	197.26	45.30	346.24	168.94	385.25	314.56	171.88
430	38°42′	83°12.30′	200.74	48.29	347.75	178.82	391.04	326.45	180.09
440	39°36′	87°07.20′	204.09	51.37	348.60	188.78	396.43	339.10	189.02
450	40°30′	91°07.50′	207.31	54.53	348.75	198.78	401.42	352.66	198.82
460	41°24′	95°13.20′	210.38	57.78	348.20	208.76	405.99	367.27	209.63
470	42°18′	99°24.30′	213.30	61.10	346.93	218.68	410.10	383.15	221.66
480	43°12′	103°40.80′	216.06	64.48	344.93	228.48	413.74	400.54	235.15

THE STANDARD HIGHWAY SPIRAL

a = 10.0

L	D	S	q	p	Y	X	C	U	V
10	1°00′	0°03.00′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	2°00′	0°12.00′	10.00	0.01	20.00	0.02	20.00	13.33	6.67
30	3°00′	0°27.00′	15.00	0.02	30.00	0.08	30.00	20.00	10.00
40	4°00′	0°48.00′	20.00	0.05	40.00	0.19	40.00	26.67	13.33
50	5°00′	1°15.00′	25.00	0.09	50.00	0.36	50.00	33.33	16.67
60	6°00′	1°48.00′	30.00	0.16	59.99	0.63	60.00	40.00	20.00
70	7°00′	2°27.00′	35.00	0.25	69.99	1.00	69.99	46.67	23.34
80	8°00′	3°12.00′	40.00	0.37	79.98	1.49	79.99	53.34	26.67
90	9°00′	4°03.00′	44.99	0.53	89.96	2.12	89.98	60.02	30.01
100	10°00′	5°00.00′	49.99	0.73	99.92	2.91	99.97	66.69	33.36
110	11°00′	6°03.00′	54.98	0.97	109.88	3.87	109.95	73.38	36.71
120	12°00′	7°12.00′	59.97	1.26	119.81	5.02	119.92	80.07	40.06
130	13°00′	8°27.00′	64.95	1.60	129.72	6.38	129.87	86.77	43.42
140	14°00′	9°48.00′	69.93	1.99	139.59	7.97	139.82	93.48	46.80
150	15°00′	11°15.00′	74.90	2.45	149.42	9.79	149.74	100.20	50.18
160	16°00′	12°48.00′	79.87	2.97	159.20	11.87	159.65	106.95	53.59
170	17°00′	14°27.00′	84.82	3.56	168.92	14.23	169.52	113.71	57.01
180	18°00′	16°12.00′	89.76	4.23	178.57	16.87	179.36	120.51	60.46
190	19°00′	18°03.00′	94.69	4.97	188.12	19.81	189.16	127.33	63.94
200	20°00′	20°00.00′	99.60	5.79	197.58	23.07	198.92	134.19	67.45
210	21°00′	22°03.00′	104.48	6.70	206.91	26.66	208.62	141.10	71.00
220	22°00′	24°12.00′	109.35	7.69	216.11	30.58	218.26	148.06	74.60
230	23°00′	26°27.00′	114.19	8.78	225.15	34.86	227.83	155.08	78.26
240	24°00′	28°48.00′	119.00	9.96	234.01	39.49	237.32	162.17	81.98
250	25°00′	31°15.00′	123.77	11.24	242.66	44.49	246.71	169.34	85.77
260	26°00′	33°48.00′	128.51	12.62	251.10	49.87	256.00	176.60	89.65
270	27°00′	36°27.00′	133.20	14.11	259.28	55.62	265.17	183.97	93.62
280	28°00′	39°12.00′	137.84	15.70	267.17	61.75	274.22	191.46	97.70
290	29°00′	42°03.00′	142.44	17.40	274.76	68.26	283.12	199.09	101.92
300	30°00′	45°00.00′	146.97	19.21	282.02	75.15	291.86	206.87	106.27
310	31°00′	48°03.00′	151.44	21.13	288.90	82.40	300.42	214.83	110.79
320	32°00′	51°12.00′	155.83	23.16	295.37	90.02	308.79	223.00	115.51
330	33°00′	54°27.00′	160.16	25.31	301.42	97.98	316.94	231.40	120.43
340	34°00′	57°48.00′	164.39	27.57	306.99	106.28	324.87	240.06	125.60
350	35°00′	61°15.00′	168.54	29.94	312.06	114.90	332.54	249.03	131.06
360	36°00′	64°48.00′	172.59	32.42	316.60	123.81	339.95	258.34	136.83
370	37°00′	68°27.00′	176.54	35.01	320.57	132.99	347.06	268.05	142.96
380	38°00′	72°12.00′	180.38	37.72	323.94	142.40	353.85	278.22	149.56
390	39°00′	76°03.00′	184.09	40.52	326.67	152.02	360.31	288.91	156.64
400	40°00′	80°00.00′	187.68	43.43	328.75	161.80	366.41	300.22	164.29
410	41°00′	84°03.00′	191.14	46.44	330.14	171.70	372.12	312.24	172.63
420	42°00′	88°12.00′	194.46	49.54	330.81	181.67	377.42	325.10	181.76
430	43°00′	92°27.00′	197.63	52.73	330.76	191.67	382.28	338.96	191.85
440	44°00′	96°48.00′	200.65	56.00	329.95	201.64	386.69	354.00	203.07
450	45°00′	101°15.00′	203.51	59.35	328.39	211.51	390.61	370.46	215.65

THE STANDARD HIGHWAY SPIRAL

$a = 12.5$

L	D	S	q	p	Y	X	C	U	V
10	1°15′	0°03.75′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	2°30′	0°15.00′	10.00	0.01	20.00	0.03	20.00	13.33	6.67
30	3°45′	0°33.75′	15.00	0.02	30.00	0.10	30.00	20.00	10.00
40	5°00′	1°00.00′	20.00	0.06	40.00	0.23	40.00	26.67	13.33
50	6°15′	1°33.75′	25.00	0.11	50.00	0.45	50.00	33.33	16.67
60	7°30′	2°15.00′	30.00	0.20	59.99	0.79	60.00	40.00	20.00
70	8°45′	3°03.75′	35.00	0.31	69.98	1.25	69.99	46.67	23.34
80	10°00′	4°00.00′	39.99	0.47	79.96	1.86	79.98	53.35	26.68
90	11°15′	5°03.75′	44.99	0.66	89.93	2.65	89.97	60.02	30.02
100	12°30′	6°15.00′	49.98	0.91	99.88	3.63	99.95	66.71	33.37
110	13°45′	7°33.75′	54.97	1.21	109.81	4.83	109.91	73.40	36.73
120	15°00′	9°00.00′	59.95	1.57	119.70	6.27	119.87	80.10	40.09
130	16°15′	10°33.75′	64.93	1.99	129.56	7.97	129.80	86.82	43.47
140	17°30′	12°15.00′	69.89	2.49	139.36	9.94	139.72	93.56	46.87
150	18°45′	14°03.75′	74.85	3.06	149.10	12.22	149.60	100.32	50.29
160	20°00′	16°00.00′	79.79	3.71	158.76	14.81	159.45	107.11	53.73
170	21°15′	18°03.75′	84.72	4.45	168.32	17.74	169.25	113.93	57.21
180	22°30′	20°15.00′	89.63	5.28	177.76	21.02	179.00	120.79	60.72
190	23°45′	22°33.75′	94.51	6.20	187.07	24.67	188.69	127.71	64.28
200	25°00′	25°00.00′	99.37	7.22	196.23	28.70	198.31	134.69	67.90
210	26°15′	27°33.75′	104.20	8.35	205.19	33.12	207.85	141.74	71.58
220	27°30′	30°15.00′	108.99	9.58	213.95	37.95	217.29	148.87	75.34
230	28°45′	33°03.75′	113.74	10.93	222.46	43.20	226.61	156.10	79.18
240	30°00′	36°00.00′	118.44	12.39	230.70	48.87	235.82	163.44	83.14
250	31°15′	39°03.75′	123.09	13.97	238.63	54.96	244.87	170.91	87.21
260	32°30′	42°15.00′	127.68	15.67	246.21	61.47	253.77	178.54	91.42
270	33°45′	45°33.75′	132.20	17.49	253.42	68.40	262.49	186.35	95.80
280	35°00′	49°00.00′	136.66	19.44	260.20	75.75	271.00	194.36	100.36
290	36°15′	52°33.75′	141.03	21.52	266.53	83.49	279.30	202.61	105.15
300	37°30′	56°15.00′	145.31	23.72	272.35	91.62	287.34	211.13	110.19
310	38°45′	60°03.75′	149.49	26.04	277.62	100.11	295.12	219.97	115.53
320	40°00′	64°00.00′	153.57	28.49	282.31	108.94	302.60	229.18	121.21
330	41°15′	68°03.75′	157.54	31.07	286.38	118.08	309.76	238.82	127.29
340	42°30′	72°15.00′	161.38	33.77	289.77	127.48	316.57	248.97	133.85
350	43°45′	76°33.75′	165.09	36.58	292.46	137.11	323.01	259.70	140.97
360	45°00′	81°00.00′	168.65	39.51	294.41	146.92	329.03	271.14	148.75
370	46°15′	85°33.75′	172.07	42.55	295.58	156.84	334.62	283.41	157.32
380	47°30′	90°15.00′	175.33	45.69	295.95	166.83	339.73	296.68	166.84
390	48°45′	95°03.75′	178.41	48.92	295.49	176.82	344.35	311.15	177.51
400	50°00′	100°00.00′	181.33	52.24	294.18	186.73	348.44	327.10	189.61

THE STANDARD HIGHWAY SPIRAL

a = 15.0

L	D	S	q	p	Y	X	C	U	V
10	1°30′	0°04.50′	5.00	0.00	10.00	0.00	10.00	6.67	3.33
20	3°00′	0°18.00′	10.00	0.01	20.00	0.03	20.00	13.33	6.67
30	4°30′	0°40.50′	15.00	0.03	30.00	0.12	30.00	20.00	10.00
40	6°00′	1°12.00′	20.00	0.07	40.00	0.28	40.00	26.67	13.33
50	7°30′	1°52.50′	25.00	0.14	49.99	0.55	50.00	33.34	16.67
60	9°00′	2°42.00′	30.00	0.24	59.99	0.94	59.99	40.00	20.00
70	10°30′	3°40.50′	35.00	0.37	69.97	1.50	69.99	46.68	23.34
80	12°00′	4°48.00′	39.99	0.56	79.94	2.23	79.98	53.35	26.68
90	13°30′	6°04.50′	44.98	0.79	89.90	3.18	89.96	60.04	30.03
100	15°00′	7°30.00′	49.97	1.09	99.83	4.36	99.92	66.73	33.39
110	16°30′	9°04.50′	54.95	1.45	109.72	5.80	109.88	73.43	36.75
120	18°00′	10°48.00′	59.93	1.88	119.57	7.52	119.81	80.15	40.14
130	19°30′	12°40.50′	64.89	2.39	129.37	9.55	129.72	86.89	43.54
140	21°00′	14°42.00′	69.85	2.99	139.08	11.92	139.59	93.66	46.96
150	22°30′	16°52.50′	74.78	3.67	148.70	14.64	149.42	100.46	50.42
160	24°00′	19°12.00′	79.70	4.45	158.21	17.73	159.20	107.30	53.91
170	25°30′	21°40.50′	84.60	5.33	167.58	21.22	168.92	114.19	57.45
180	27°00′	24°18.00′	89.46	6.32	176.79	25.12	178.57	121.15	61.05
190	28°30′	27°04.50′	94.30	7.42	185.80	29.45	188.12	128.18	64.71
200	30°00′	30°00.00′	99.09	8.64	194.59	34.23	197.57	135.30	68.46
210	31°30′	33°04.50′	103.84	9.98	203.11	39.46	206.91	142.52	72.30
220	33°00′	36°18.00′	108.54	11.45	211.33	45.15	216.10	149.87	76.26
230	34°30′	39°40.50′	113.19	13.05	219.21	51.30	225.14	157.37	80.35
240	36°00′	43°12.00′	117.76	14.78	226.71	57.91	233.99	165.04	84.60
250	37°30′	46°52.50′	122.26	16.64	233.78	64.99	242.64	172.91	89.04
260	39°00′	50°42.00′	126.68	18.65	240.37	72.51	251.06	181.02	93.70
270	40°30′	54°40.50′	131.00	20.79	246.43	80.46	259.23	189.41	98.61
280	42°00′	58°48.00′	135.23	23.07	251.91	88.82	267.11	198.13	103.83
290	43°30′	63°04.50′	139.34	25.48	256.77	97.55	274.68	207.23	109.41
300	45°00′	67°30.00′	143.32	28.03	260.95	106.63	281.90	216.78	115.42
310	46°30′	72°04.50′	147.17	30.72	264.41	116.01	288.74	226.88	121.93
320	48°00′	76°48.00′	150.88	33.54	267.09	125.64	295.17	237.62	129.05
330	49°30′	81°40.50′	154.43	36.48	268.96	135.47	301.15	249.14	136.91
340	51°00′	86°42.00′	157.82	39.53	269.98	145.41	306.65	261.59	145.65
350	52°30′	91°52.50′	161.03	42.70	270.10	155.41	311.62	275.19	155.49
360	54°00′	97°12.00′	164.05	45.97	269.32	165.37	316.04	290.21	166.69
370	55°30′	102°40.50′	166.87	49.33	267.59	175.22	319.86	307.00	179.60

THE STANDARD HIGHWAY SPIRAL

a = 20.0

L	D	S	q	p	Y	X	C	U	V
10	2°00′	0°06.00′	5.00	0.00	10.00	0.01	10.00	6.67	3.33
20	4°00′	0°24.00′	10.00	0.01	20.00	0.05	20.00	13.33	6.67
30	6°00′	0°54.00′	15.00	0.04	30.00	0.16	30.00	20.00	10.00
40	8°00′	1°36.00′	20.00	0.09	40.00	0.37	40.00	26.67	13.33
50	10°00′	2°30.00′	25.00	0.18	49.99	0.73	50.00	33.34	16.67
60	12°00′	3°36.00′	30.00	0.31	59.98	1.26	59.99	40.01	20.01
70	14°00′	4°54.00′	34.99	0.50	69.95	1.99	69.98	46.68	23.35
80	16°00′	6°24.00′	39.98	0.74	79.90	2.98	79.96	53.37	26.70
90	18°00′	8°06.00′	44.97	1.06	89.82	4.24	89.92	60.06	30.06
100	20°00′	10°00.00′	49.95	1.45	99.70	5.81	99.86	66.77	33.43
110	22°00′	12°06.00′	54.92	1.93	109.51	7.72	109.78	73.51	36.82
120	24°00′	14°24.00′	59.87	2.51	119.24	10.01	119.66	80.27	40.24
130	26°00′	16°54.00′	64.81	3.19	128.87	12.70	129.50	87.06	43.70
140	28°00′	19°36.00′	69.73	3.97	138.37	15.83	139.27	93.91	47.19
150	30°00′	22°30.00′	74.62	4.88	147.70	19.42	148.97	100.82	50.75
160	32°00′	25°36.00′	79.47	5.92	156.84	23.49	158.58	107.80	54.37
170	34°00′	28°54.00′	84.28	7.08	165.73	28.07	168.09	114.88	58.08
180	36°00′	32°24.00′	89.05	8.39	174.33	33.16	177.45	122.07	61.89
190	38°00′	36°06.00′	93.76	9.84	182.59	38.79	186.67	129.40	65.83
200	40°00′	40°00.00′	98.40	11.44	190.47	44.95	195.70	136.90	69.92
210	42°00′	44°06.00′	102.96	13.19	197.90	51.64	204.52	144.61	74.21
220	44°00′	48°24.00′	107.43	15.10	204.81	58.86	213.10	152.55	78.71
230	46°00′	52°54.00′	111.81	17.17	211.15	66.59	221.40	160.79	83.49
240	48°00′	57°36.00′	116.07	19.40	216.85	74.80	229.39	169.38	88.59
250	50°00′	62°30.00′	120.20	21.78	221.85	83.46	237.03	178.40	94.09
260	52°00′	67°36.00′	124.20	24.33	226.07	92.53	244.27	187.93	100.08
270	54°00′	72°54.00′	128.03	27.03	229.45	101.93	251.07	198.09	106.65
280	56°00′	78°24.00′	131.70	29.88	231.93	111.62	257.39	209.02	113.94
290	58°00′	84°06.00′	135.19	32.86	233.45	121.50	263.17	220.90	122.14
300	60°00′	90°00.00′	138.48	35.98	233.97	131.48	268.38	233.97	131.48
310	62°00′	96°06.00′	141.55	39.23	233.44	141.46	272.96	248.56	142.26
320	64°00′	102°24.00′	144.40	42.58	231.84	151.32	276.85	265.11	154.94

THE STANDARD HIGHWAY SPIRAL

a = 25.0

L	D	S	q	p	Y	X	C	U	V
10	2°30′	0°07.50′	5.00	0.00	10.00	0.01	10.00	6.67	3.33
20	5°00′	0°30.00′	10.00	0.01	20.00	0.06	20.00	13.33	6.67
30	7°30′	1°07.50′	15.00	0.05	30.00	0.20	30.00	20.00	10.00
40	10°00′	2°00.00′	20.00	0.12	40.00	0.47	40.00	26.67	13.33
50	12°30′	3°07.50′	25.00	0.23	49.99	0.91	49.99	33.34	16.67
60	15°00′	4°30.00′	29.99	0.39	59.96	1.57	59.98	40.01	20.01
70	17°30′	6°07.50′	34.99	0.62	69.92	2.49	69.96	46.69	23.36
80	20°00′	8°00.00′	39.97	0.93	79.84	3.72	79.93	53.39	26.72
90	22°30′	10°07.50′	44.95	1.32	89.72	5.29	89.88	60.10	30.09
100	25°00′	12°30.00′	49.92	1.81	99.53	7.25	99.79	66.83	33.49
110	27°30′	15°07.50′	54.87	2.41	109.24	9.63	109.66	73.60	36.91
120	30°00′	18°00.00′	59.80	3.13	118.82	12.48	119.47	80.42	40.38
130	32°30′	21°07.50′	64.71	3.97	128.24	15.82	129.22	87.29	43.90
140	35°00′	24°30.00′	69.58	4.96	137.46	19.70	138.87	94.24	47.49
150	37°30′	28°07.50′	74.40	6.08	146.43	24.12	148.40	101.29	51.18
160	40°00′	32°00.00′	79.18	7.36	155.08	29.13	157.79	108.46	54.97
170	42°30′	36°07.50′	83.89	8.81	163.37	34.73	167.02	115.79	58.90
180	45°00′	40°30.00′	88.52	10.42	171.21	40.92	176.03	123.30	63.01
190	47°30′	45°07.50′	93.07	12.20	178.55	47.71	184.81	131.04	67.33
200	50°00′	50°00.00′	97.51	14.16	185.30	55.09	193.31	139.07	71.91
210	52°30′	55°07.50′	101.84	16.29	191.38	63.02	201.49	147.45	76.82
220	55°00′	60°30.00′	106.04	18.61	196.70	71.48	209.29	156.26	82.13
230	57°30′	66°07.50′	110.08	21.10	201.20	80.41	216.67	165.61	87.94
240	60°00′	72°00.00′	113.95	23.76	204.77	89.75	223.58	175.61	94.36
250	62°30′	78°07.50′	117.64	26.59	207.35	99.40	229.95	186.45	101.58
260	65°00′	84°30.00′	121.12	29.58	208.87	109.28	235.73	198.34	109.79
270	67°30′	91°07.50′	124.38	32.72	209.25	119.27	240.85	211.59	119.29
280	70°00′	98°00.00′	127.41	35.99	208.46	129.23	245.27	226.62	130.50
290	72°30′	105°07.50′	130.17	39.37	206.46	139.02	248.90	244.04	144.01

Part 2

SUPPLEMENTARY SPIRAL TABLES

These supplementary spiral tables are to be used in spiraling curves where conditions do not permit the use of the standards given on page 9 of this bulletin. Whenever possible, standards shall apply.

Spiral values are given to three decimal places as an aid in the computation of curves. Do not show these values to more than two decimal places on maps and profiles.

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	1.0000	0.5000	0.3333	0.2500	0.2000	0.1667	0.1429	0.1250	0.1111	0.1000	0.0909	0.0833	0.0769	0.0714	0.0667	0.0625	0.0588	0.0556	0.0526	0.0500
1°00′	2.0000	1.0000	0.6667	0.5000	0.4000	0.3333	0.2857	0.2500	0.2222	0.2000	0.1818	0.1667	0.1538	0.1429	0.1333	0.1250	0.1176	0.1111	0.1053	0.1000
1°30′	3.0000	1.5000	1.0000	0.7500	0.6000	0.5000	0.4286	0.3750	0.3333	0.3000	0.2727	0.2500	0.2308	0.2143	0.2000	0.1875	0.1765	0.1667	0.1579	0.1500
2°00′	4.0000	2.0000	1.3333	1.0000	0.8000	0.6667	0.5714	0.5000	0.4444	0.4000	0.3636	0.3333	0.3077	0.2857	0.2667	0.2500	0.2353	0.2222	0.2105	0.2000
2°30′	5.0000	2.5000	1.6667	1.2500	1.0000	0.8333	0.7143	0.6250	0.5556	0.5000	0.4545	0.4167	0.3846	0.3571	0.3333	0.3125	0.2941	0.2778	0.2632	0.2500
3°00′	6.0000	3.0000	2.0000	1.5000	1.2000	1.0000	0.8571	0.7500	0.6667	0.6000	0.5455	0.5000	0.4615	0.4286	0.4000	0.3750	0.3529	0.3333	0.3158	0.3000
3°30′	7.0000	3.5000	2.3333	1.7500	1.4000	1.1667	1.0000	0.8750	0.7778	0.7000	0.6364	0.5833	0.5385	0.5000	0.4667	0.4375	0.4118	0.3889	0.3684	0.3500
4°00′	8.0000	4.0000	2.6667	2.0000	1.6000	1.3333	1.1429	1.0000	0.8889	0.8000	0.7273	0.6667	0.6154	0.5714	0.5333	0.5000	0.4706	0.4444	0.4211	0.4000
4°30′	9.0000	4.5000	3.0000	2.2500	1.8000	1.5000	1.2857	1.1250	1.0000	0.9000	0.8182	0.7500	0.6923	0.6429	0.6000	0.5625	0.5294	0.5000	0.4737	0.4500
5°00′	10.0000	5.0000	3.3333	2.5000	2.0000	1.6667	1.4286	1.2500	1.1111	1.0000	0.9091	0.8333	0.7692	0.7143	0.6667	0.6250	0.5882	0.5556	0.5263	0.5000
5°30′	11.0000	5.5000	3.6667	2.7500	2.2000	1.8333	1.5714	1.3750	1.2222	1.1000	1.0000	0.9167	0.8462	0.7857	0.7333	0.6875	0.6471	0.6111	0.5789	0.5500
6°00′	12.0000	6.0000	4.0000	3.0000	2.4000	2.0000	1.7143	1.5000	1.3333	1.2000	1.0909	1.0000	0.9231	0.8571	0.8000	0.7500	0.7059	0.6667	0.6316	0.6000
6°30′	13.0000	6.5000	4.3333	3.2500	2.6000	2.1667	1.8571	1.6250	1.4444	1.3000	1.1818	1.0833	1.0000	0.9286	0.8667	0.8125	0.7647	0.7222	0.6842	0.6500
7°00′	14.0000	7.0000	4.6667	3.5000	2.8000	2.3333	2.0000	1.7500	1.5556	1.4000	1.2727	1.1667	1.0769	1.0000	0.9333	0.8750	0.8235	0.7778	0.7368	0.7000
7°30′	15.0000	7.5000	5.0000	3.7500	3.0000	2.5000	2.1429	1.8750	1.6667	1.5000	1.3636	1.2500	1.1538	1.0714	1.0000	0.9375	0.8824	0.8333	0.7895	0.7500
8°00′	16.0000	8.0000	5.3333	4.0000	3.2000	2.6667	2.2857	2.0000	1.7778	1.6000	1.4545	1.3333	1.2308	1.1429	1.0667	1.0000	0.9412	0.8889	0.8421	0.8000
8°30′	17.0000	8.5000	5.6667	4.2500	3.4000	2.8333	2.4286	2.1250	1.8889	1.7000	1.5455	1.4167	1.3077	1.2143	1.1333	1.0625	1.0000	0.9444	0.8947	0.8500
9°00′	18.0000	9.0000	6.0000	4.5000	3.6000	3.0000	2.5714	2.2500	2.0000	1.8000	1.6364	1.5000	1.3846	1.2857	1.2000	1.1250	1.0588	1.0000	0.9474	0.9000
9°30′	19.0000	9.5000	6.3333	4.7500	3.8000	3.1667	2.7143	2.3750	2.1111	1.9000	1.7273	1.5833	1.4615	1.3571	1.2667	1.1875	1.1176	1.0556	1.0000	0.9500
10°00′	20.0000	10.0000	6.6667	5.0000	4.0000	3.3333	2.8571	2.5000	2.2222	2.0000	1.8182	1.6667	1.5385	1.4286	1.3333	1.2500	1.1765	1.1111	1.0526	1.0000

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	0.125°	0.250°	0.375°	0.500°	0.625°	0.750°	0.875°	1.000°	1.125°	1.250°	1.375°	1.500°	1.625°	1.750°	1.875°	2.000°	2.125°	2.250°	2.375°	2.500°
1°00′	0.250°	0.500°	0.750°	1.000°	1.250°	1.500°	1.750°	2.000°	2.250°	2.500°	2.750°	3.000°	3.250°	3.500°	3.750°	4.000°	4.250°	4.500°	4.750°	5.000°
1°30′	0.375°	0.750°	1.125°	1.500°	1.875°	2.250°	2.625°	3.000°	3.375°	3.750°	4.125°	4.500°	4.875°	5.250°	5.625°	6.000°	6.375°	6.750°	7.125°	7.500°
2°00′	0.500°	1.000°	1.500°	2.000°	2.500°	3.000°	3.500°	4.000°	4.500°	5.000°	5.500°	6.000°	6.500°	7.000°	7.500°	8.000°	8.500°	9.000°	9.500°	10.000°
2°30′	0.625°	1.250°	1.875°	2.500°	3.125°	3.750°	4.375°	5.000°	5.625°	6.250°	6.875°	7.500°	8.125°	8.750°	9.375°	10.000°	10.625°	11.250°	11.875°	12.500°
3°00′	0.750°	1.500°	2.250°	3.000°	3.750°	4.500°	5.250°	6.000°	6.750°	7.500°	8.250°	9.000°	9.750°	10.500°	11.250°	12.000°	12.750°	13.500°	14.250°	15.000°
3°30′	0.875°	1.750°	2.625°	3.500°	4.375°	5.250°	6.125°	7.000°	7.875°	8.750°	9.625°	10.500°	11.375°	12.250°	13.125°	14.000°	14.875°	15.750°	16.625°	17.500°
4°00′	1.000°	2.000°	3.000°	4.000°	5.000°	6.000°	7.000°	8.000°	9.000°	10.000°	11.000°	12.000°	13.000°	14.000°	15.000°	16.000°	17.000°	18.000°	19.000°	20.000°
4°30′	1.125°	2.250°	3.375°	4.500°	5.625°	6.750°	7.875°	9.000°	10.125°	11.250°	12.375°	13.500°	14.625°	15.750°	16.875°	18.000°	19.125°	20.250°	21.375°	22.500°
5°00′	1.250°	2.500°	3.750°	5.000°	6.250°	7.500°	8.750°	10.000°	11.250°	12.500°	13.750°	15.000°	16.250°	17.500°	18.750°	20.000°	21.250°	22.500°	23.750°	25.000°
5°30′	1.375°	2.750°	4.125°	5.500°	6.875°	8.250°	9.625°	11.000°	12.375°	13.750°	15.125°	16.500°	17.875°	19.250°	20.625°	22.000°	23.375°	24.750°	26.125°	27.500°
6°00′	1.500°	3.000°	4.500°	6.000°	7.500°	9.000°	10.500°	12.000°	13.500°	15.000°	16.500°	18.000°	19.500°	21.000°	22.500°	24.000°	25.500°	27.000°	28.500°	30.000°
6°30′	1.625°	3.250°	4.875°	6.500°	8.125°	9.750°	11.375°	13.000°	14.625°	16.250°	17.875°	19.500°	21.125°	22.750°	24.375°	26.000°	27.625°	29.250°	30.875°	32.500°
7°00′	1.750°	3.500°	5.250°	7.000°	8.750°	10.500°	12.250°	14.000°	15.750°	17.500°	19.250°	21.000°	22.750°	24.500°	26.250°	28.000°	29.750°	31.500°	33.250°	35.000°
7°30′	1.875°	3.750°	5.625°	7.500°	9.375°	11.250°	13.125°	15.000°	16.875°	18.750°	20.625°	22.500°	24.375°	26.250°	28.125°	30.000°	31.875°	33.750°	35.625°	37.500°
8°00′	2.000°	4.000°	6.000°	8.000°	10.000°	12.000°	14.000°	16.000°	18.000°	20.000°	22.000°	24.000°	26.000°	28.000°	30.000°	32.000°	34.000°	36.000°	38.000°	40.000°
8°30′	2.125°	4.250°	6.375°	8.500°	10.625°	12.750°	14.875°	17.000°	19.125°	21.250°	23.375°	25.500°	27.625°	29.750°	31.875°	34.000°	36.125°	38.250°	40.375°	42.500°
9°00′	2.250°	4.500°	6.750°	9.000°	11.250°	13.500°	15.750°	18.000°	20.250°	22.500°	24.750°	27.000°	29.250°	31.500°	33.750°	36.000°	38.250°	40.500°	42.750°	45.000°
9°30′	2.375°	4.750°	7.125°	9.500°	11.875°	14.250°	16.625°	19.000°	21.375°	23.750°	26.125°	28.500°	30.875°	33.250°	35.625°	38.000°	40.375°	42.750°	45.125°	47.500°
10°00′	2.500°	5.000°	7.500°	10.000°	12.500°	15.000°	17.500°	20.000°	22.500°	25.000°	27.500°	30.000°	32.500°	35.000°	37.500°	40.000°	42.500°	45.000°	47.500°	50.000°

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	25.000	50.000	75.000	99.999	125.000	149.999	174.999	199.998	224.998	249.996	274.994	299.993	324.992	349.989	374.987	399.984	424.981	449.977	474.973	499.969
1°00′	25.000	50.000	74.999	99.999	124.998	149.996	174.994	199.992	224.989	249.984	274.979	299.973	324.965	349.957	374.947	399.935	424.922	449.908	474.891	499.873
1°30′	25.000	49.999	74.999	99.997	124.995	149.993	174.988	199.981	224.974	249.964	274.953	299.938	324.922	349.902	374.879	399.854	424.824	449.792	474.755	499.715
2°00′	25.000	50.000	74.999	99.996	124.992	149.987	174.978	199.967	224.953	249.936	274.915	299.890	324.861	349.826	374.786	399.740	424.688	449.630	474.565	499.493
2°30′	25.000	49.999	74.997	99.994	124.988	149.979	174.966	199.949	224.927	249.901	274.868	299.829	324.782	349.728	374.665	399.594	424.514	449.422	474.320	499.208
3°00′	25.000	49.999	74.996	99.991	124.982	149.969	174.951	199.927	224.896	249.857	274.810	299.753	324.686	349.609	374.519	399.416	424.299	449.168	474.022	498.860
3°30′	25.000	49.999	74.995	99.987	124.975	149.958	174.933	199.900	224.859	249.806	274.742	299.664	324.574	349.467	374.345	399.205	424.047	448.869	473.670	498.449
4°00′	24.999	49.998	74.993	99.984	124.969	149.945	174.913	199.870	224.815	249.746	274.662	299.561	324.443	349.304	374.145	398.963	423.755	448.524	473.264	497.976
4°30′	25.000	49.998	74.991	99.980	124.960	149.931	174.889	199.835	224.766	249.679	274.573	299.446	324.296	349.120	373.918	398.687	423.426	448.133	472.805	497.440
5°00′	25.000	49.997	74.990	99.975	124.951	149.914	174.864	199.797	224.711	249.603	274.473	299.316	324.131	348.915	373.666	398.381	423.059	447.697	472.292	496.843
5°30′	24.999	49.996	74.987	99.970	124.940	149.897	174.836	199.754	224.650	249.521	274.363	299.172	323.948	348.688	373.337	398.042	422.653	447.216	471.727	496.185
6°00′	25.000	49.996	74.984	99.964	124.929	149.877	174.804	199.703	224.584	249.430	274.241	299.016	323.749	348.439	373.080	397.672	422.209	446.689	471.109	495.465
6°30′	24.999	49.995	74.981	99.957	124.917	149.855	174.770	199.658	224.512	249.331	274.110	298.845	323.533	348.169	372.749	397.270	421.728	446.119	470.439	494.686
7°00′	24.999	49.994	74.979	99.951	124.903	149.832	174.733	199.602	224.434	249.225	273.969	298.662	323.300	347.878	372.392	396.836	421.209	445.504	469.717	493.844
7°30′	24.999	49.993	74.975	99.943	124.888	149.807	174.695	199.544	224.351	249.110	273.817	298.464	323.049	347.565	372.008	396.372	420.653	444.846	468.944	492.945
8°00′	24.999	49.992	74.973	99.935	124.874	149.781	174.652	199.481	224.262	248.988	273.654	298.254	322.782	347.232	371.599	395.877	420.060	444.143	468.120	491.986
8°30′	24.999	49.991	74.969	99.926	124.857	149.753	174.607	199.415	224.167	248.858	273.481	298.030	322.497	346.878	371.164	395.351	419.430	443.397	467.245	490.968
9°00′	24.998	49.989	74.965	99.918	124.840	149.723	174.560	199.344	224.066	248.720	273.298	297.793	322.197	346.503	370.704	394.793	418.764	442.609	466.320	489.894
9°30′	24.998	49.988	74.961	99.909	124.821	149.692	174.510	199.269	223.960	248.575	273.105	297.543	321.879	346.108	370.219	394.206	418.062	441.777	465.346	488.761
10°00′	24.998	49.987	74.957	99.899	124.802	149.658	174.457	199.191	223.849	248.422	272.902	297.279	321.545	345.691	369.708	393.589	417.323	440.905	464.323	487.573

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	0.009	0.036	0.082	0.146	0.227	0.327	0.446	0.582	0.736	0.909	1.100	1.309	1.537	1.781	2.046	2.327	2.627	2.945	3.282	3.635
1°00′	0.018	0.073	0.163	0.291	0.454	0.655	0.891	1.164	1.473	1.818	2.200	2.618	3.072	3.563	4.090	4.653	5.253	5.890	6.562	7.270
1°30′	0.027	0.109	0.246	0.436	0.682	0.982	1.336	1.745	2.209	2.727	3.299	3.926	4.608	5.343	6.134	6.978	7.876	8.831	9.840	10.902
2°00′	0.036	0.146	0.327	0.582	0.909	1.309	1.782	2.327	2.945	3.635	4.398	5.234	6.142	7.123	8.176	9.302	10.500	11.771	13.113	14.528
2°30′	0.046	0.182	0.409	0.727	1.136	1.636	2.227	2.908	3.680	4.543	5.497	6.541	7.676	8.901	10.217	11.623	13.120	14.706	16.383	18.149
3°00′	0.054	0.219	0.491	0.873	1.363	1.964	2.672	3.490	4.416	5.451	6.595	7.847	9.208	10.677	12.255	13.941	15.734	17.636	19.646	21.763
3°30′	0.064	0.254	0.572	1.016	1.591	2.290	3.117	4.070	5.151	6.358	7.692	9.152	10.739	12.452	14.290	16.255	18.345	20.561	22.902	25.368
4°00′	0.073	0.290	0.654	1.164	1.817	2.617	3.561	4.651	5.885	7.265	8.788	10.456	12.268	14.223	16.322	18.565	20.951	23.479	26.150	28.962
4°30′	0.082	0.327	0.737	1.309	2.045	2.943	4.007	5.231	6.619	8.170	9.882	11.757	13.794	15.992	18.351	20.870	23.550	26.389	29.388	32.545
5°00′	0.091	0.363	0.818	1.454	2.272	3.271	4.450	5.811	7.353	9.075	10.976	13.058	15.319	17.758	20.375	23.170	26.142	29.290	32.615	36.115
5°30′	0.100	0.400	0.899	1.599	2.499	3.597	4.895	6.391	8.086	9.979	12.069	14.357	16.840	19.520	22.395	25.463	28.727	32.183	35.830	39.670
6°00′	0.109	0.436	0.981	1.745	2.725	3.923	5.339	6.970	8.818	10.882	13.160	15.652	18.359	21.278	24.409	27.751	31.303	35.064	39.033	43.209
6°30′	0.119	0.472	1.063	1.890	2.952	4.250	5.782	7.549	9.549	11.783	14.249	16.947	19.875	23.032	26.418	30.031	33.870	37.934	42.220	46.730
7°00′	0.127	0.509	1.145	2.035	3.179	4.576	6.225	8.128	10.280	12.684	15.337	18.238	21.387	24.781	28.420	32.303	36.427	40.791	45.393	50.232
7°30′	0.136	0.545	1.226	2.180	3.405	4.902	6.668	8.705	11.011	13.584	16.423	19.527	22.895	26.526	30.416	34.567	38.974	43.635	48.549	53.715
8°00′	0.146	0.581	1.309	2.325	3.632	5.227	7.112	9.283	11.740	14.481	17.506	20.813	24.400	28.265	32.407	36.821	41.508	46.464	51.688	57.176
8°30′	0.154	0.618	1.390	2.471	3.859	5.553	7.554	9.859	12.468	15.378	18.588	22.096	25.900	29.999	34.388	39.067	44.032	49.280	54.808	60.613
9°00′	0.163	0.655	1.472	2.616	4.085	5.879	7.996	10.436	13.194	16.272	19.667	23.376	27.396	31.727	36.362	41.302	46.542	52.079	57.907	64.026
9°30′	0.173	0.691	1.554	2.761	4.312	6.204	8.438	11.011	13.921	17.166	20.744	24.652	28.888	33.448	38.328	43.526	49.039	54.860	60.987	67.415
10°00′	0.182	0.727	1.635	2.905	4.538	6.529	8.879	11.585	14.645	18.057	21.818	25.925	30.374	35.163	40.286	45.740	51.521	57.624	64.044	70.775

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	50.000	100.000	149.999	199.998	249.997	299.995	349.992	399.988	449.983	499.976	549.968	599.959	649.948	699.935	749.920	799.903	849.883	899.861	949.837	999.810
1°00′	50.000	99.999	149.997	199.994	249.988	299.979	349.967	399.951	449.931	499.905	549.873	599.836	649.791	699.739	749.679	799.610	849.532	899.445	949.347	999.239
1°30′	50.000	99.998	149.994	199.986	249.973	299.954	349.927	399.890	449.844	499.786	549.715	599.630	649.530	699.412	749.277	799.123	848.948	898.752	948.532	998.283
2°00′	50.000	99.997	149.990	199.976	249.952	299.918	349.869	399.805	449.722	499.619	549.493	599.342	649.164	698.956	748.716	798.442	848.131	897.782	947.392	996.958
2°30′	49.999	99.995	149.984	199.962	249.926	299.872	349.796	399.695	449.566	499.405	549.209	598.973	668.694	698.369	747.994	797.566	847.082	896.536	945.927	995.251
3°00′	49.999	99.993	149.977	199.945	249.893	299.815	349.706	399.562	449.376	499.144	548.861	598.521	648.120	697.653	747.114	796.498	845.800	895.016	944.140	993.168
3°30′	49.999	99.991	149.969	199.925	249.854	299.748	349.600	399.403	449.151	498.835	548.450	597.988	647.443	696.807	746.074	795.237	844.289	893.223	942.033	990.711
4°00′	49.998	99.988	149.959	199.903	249.810	299.671	349.478	399.221	448.891	498.479	547.976	597.373	646.662	695.832	744.876	793.784	842.547	891.158	939.606	987.884
4°30′	49.998	99.985	149.948	199.877	249.759	299.584	349.339	399.014	448.597	498.076	547.440	596.678	645.778	694.729	743.520	792.140	840.578	888.823	936.863	984.688
5°00′	49.998	99.981	149.936	199.848	249.703	299.486	349.185	398.783	448.268	497.625	546.841	595.901	644.791	693.498	742.008	790.307	838.382	886.220	933.806	981.128
5°30′	49.997	99.977	149.922	199.816	249.640	299.379	349.014	398.528	447.905	497.128	546.180	595.043	643.702	692.140	740.340	788.285	835.961	883.351	930.438	977.208
6°00′	49.997	99.973	149.907	199.781	249.572	299.261	348.826	398.249	447.508	496.584	545.456	594.105	642.511	690.655	738.516	786.077	833.317	880.218	926.762	972.930
6°30′	49.996	99.968	149.891	199.743	249.498	299.132	348.623	397.946	447.077	495.993	544.671	593.087	641.219	689.044	736.539	783.683	830.452	876.826	922.782	968.301
7°00′	49.995	99.963	149.874	199.702	249.418	298.994	348.403	397.618	446.611	495.356	543.824	591.990	639.827	687.309	734.410	781.104	827.368	873.175	918.501	963.323
7°30′	49.995	99.957	149.855	199.658	249.331	298.845	348.168	397.267	446.112	494.672	542.916	590.813	638.334	685.449	732.129	778.344	824.067	869.270	913.924	958.004
8°00′	49.994	99.951	149.836	199.610	249.240	298.687	347.916	396.892	445.579	493.942	541.946	589.558	636.742	683.466	729.698	775.404	820.552	865.113	909.055	952.349
8°30′	49.993	99.945	149.814	199.560	249.142	298.518	347.648	396.493	445.012	493.166	540.916	588.224	635.051	681.362	727.118	772.285	816.826	860.708	903.898	946.362
9°00′	49.992	99.938	149.792	199.507	249.038	298.339	347.364	396.070	444.411	492.344	539.825	586.812	633.263	679.136	724.391	768.989	812.891	856.060	898.458	940.052
9°30′	49.991	99.931	149.768	199.451	248.928	298.150	347.065	395.624	443.777	491.477	538.675	585.324	631.377	676.791	721.519	765.520	808.751	851.171	892.741	933.423
10°00′	49.990	99.924	149.743	199.392	248.813	297.950	346.749	395.154	443.110	490.564	537.464	583.758	629.395	674.326	718.503	761.879	804.408	846.047	886.752	926.484

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	0.036	0.145	0.327	0.582	0.909	1.309	1.782	2.327	2.945	3.636	4.400	5.236	6.145	7.126	8.181	9.308	10.507	11.780	13.125	14.542
1°00′	0.073	0.291	0.654	1.164	1.818	2.618	3.563	4.654	5.890	7.271	8.798	10.470	12.287	14.250	16.357	18.610	21.008	23.552	26.240	29.073
1°30′	0.109	0.436	0.982	1.745	2.727	3.927	5.344	6.980	8.834	10.905	13.194	15.701	18.426	21.367	24.527	27.903	31.497	35.308	39.336	43.580
2°00′	0.145	0.582	1.309	2.327	3.636	5.235	7.125	9.305	11.776	14.536	17.587	20.928	24.557	28.477	32.685	37.182	41.967	47.041	52.402	58.051
2°30′	0.182	0.727	1.636	2.908	4.544	6.543	8.905	11.629	14.716	18.165	21.976	26.148	30.681	35.574	40.828	46.441	52.413	58.743	65.431	72.475
3°00′	0.218	0.873	1.963	3.490	5.452	7.851	10.684	13.952	17.654	21.790	26.359	31.361	36.794	42.658	48.952	55.676	62.827	70.406	78.411	86.840
3°30′	0.255	1.018	2.290	4.071	6.361	9.157	12.462	16.272	20.589	25.410	30.736	36.564	42.894	49.725	57.054	64.882	73.205	82.023	91.333	101.134
4°00′	0.291	1.163	2.617	4.653	7.268	10.464	14.238	18.591	23.520	29.026	35.105	41.757	48.980	56.771	65.130	74.054	83.540	93.585	104.189	115.346
4°30′	0.327	1.309	2.945	5.234	8.176	11.769	16.014	20.907	26.448	32.635	39.465	46.937	55.048	63.795	73.176	83.187	93.825	105.086	116.968	129.465
5°00′	0.364	1.454	3.271	5.815	9.083	13.074	17.787	23.220	29.371	36.238	43.816	52.104	61.098	70.794	81.189	92.277	104.055	116.518	129.661	143.478
5°30′	0.400	1.600	3.598	6.395	9.989	14.378	19.559	25.531	32.290	39.833	48.156	57.256	67.127	77.765	89.164	101.319	114.225	127.874	142.259	157.375
6°00′	0.436	1.745	3.925	6.976	10.895	15.680	21.329	27.838	35.203	43.420	52.484	62.390	73.132	84.704	97.099	110.309	124.327	139.145	154.754	171.145
6°30′	0.473	1.890	4.252	7.556	11.800	16.982	23.097	30.141	38.110	46.998	56.799	67.507	79.113	91.610	104.989	119.241	134.357	150.325	167.135	184.776
7°00′	0.509	2.036	4.579	8.136	12.705	18.282	24.862	32.441	41.011	50.567	61.101	72.603	85.066	98.479	112.831	128.112	144.308	161.407	179.395	198.258
7°30′	0.545	2.181	4.905	8.716	13.609	19.581	26.625	34.736	43.906	54.126	65.387	77.679	90.990	105.309	120.622	136.916	154.175	172.383	191.524	211.581
8°00′	0.582	2.326	5.232	9.295	14.513	20.878	28.386	37.027	46.793	57.673	69.657	82.732	96.883	112.098	128.359	145.649	163.951	183.246	203.514	224.734
8°30′	0.618	2.472	5.558	9.875	15.416	22.174	30.143	39.313	49.672	61.209	73.910	87.760	102.743	118.842	136.036	154.307	173.633	193.991	215.357	237.706
9°00′	0.654	2.617	5.885	10.454	16.317	23.469	31.898	41.594	52.543	64.732	78.145	92.763	108.568	125.539	143.652	162.886	183.213	204.609	227.043	250.488
9°30′	0.691	2.762	6.211	11.032	17.219	24.761	33.649	43.869	55.406	68.243	82.361	97.739	114.356	132.186	151.203	171.380	192.688	215.094	238.566	263.071
10°00′	0.727	2.907	6.537	11.610	18.119	26.052	35.397	46.139	58.259	71.739	86.556	102.687	120.104	138.781	158.686	179.787	202.050	225.439	249.917	275.443

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	50.000	100.000	150.000	199.999	249.999	299.998	349.996	399.995	449.992	499.989	549.986	599.982	649.977	699.971	749.964	799.957	849.948	899.938	949.927	999.915
1°00′	50.000	100.000	149.999	199.997	249.995	299.991	349.985	399.978	449.969	499.958	549.944	599.927	649.907	699.884	749.857	799.827	849.792	899.753	949.710	999.662
1°30′	50.000	99.999	149.997	199.994	249.988	299.979	349.967	399.951	449.931	499.905	549.873	599.836	649.791	699.739	749.679	799.610	849.532	899.445	949.347	999.239
2°00′	50.000	99.999	149.995	199.989	249.979	299.963	349.942	399.913	449.877	499.831	549.775	599.708	649.628	699.536	749.429	799.307	849.169	899.013	948.840	998.647
2°30′	50.000	99.998	149.993	199.983	249.967	299.943	349.909	399.865	449.807	499.736	549.648	599.543	649.419	699.275	749.108	798.917	848.702	898.459	948.188	997.886
3°00′	50.000	99.997	149.990	199.976	249.952	299.918	349.869	399.805	449.722	499.619	549.493	599.342	649.164	698.956	748.716	798.441	848.131	897.781	947.391	996.957
3°30′	49.999	99.996	149.986	199.967	249.935	299.888	349.822	399.735	449.622	499.482	549.310	599.105	648.862	698.579	748.252	797.879	847.456	896.981	946.450	995.860
4°00′	49.999	99.995	149.982	199.957	249.915	299.854	349.768	399.654	449.507	499.323	549.100	598.831	648.514	698.144	747.718	797.231	846.679	896.058	945.365	994.595
4°30′	49.999	99.993	149.977	199.945	249.893	299.815	349.706	399.562	449.376	499.144	548.861	598.521	648.120	697.652	747.112	796.496	845.798	895.013	944.137	993.163
5°00′	49.999	99.992	149.971	199.932	249.868	299.772	349.637	399.459	449.229	498.943	548.593	598.174	647.679	697.102	746.436	795.676	844.815	893.847	942.765	991.564
5°30′	49.999	99.990	149.965	199.918	249.840	299.724	349.561	399.345	449.068	498.721	548.298	597.791	647.193	696.494	745.689	794.770	843.729	892.558	941.251	989.799
6°00′	49.998	99.988	149.959	199.903	249.810	299.671	349.478	399.221	448.891	498.479	547.975	597.372	646.660	695.830	744.872	793.779	842.541	891.149	939.594	987.868
6°30′	49.998	99.986	149.952	199.886	249.777	299.614	349.387	399.086	448.698	498.215	547.624	596.917	646.081	695.107	743.984	792.702	841.250	889.618	937.796	985.773
7°00′	49.998	99.983	149.944	199.867	249.741	299.552	349.289	398.940	448.491	497.930	547.246	596.425	645.457	694.328	743.027	791.541	839.858	887.968	935.857	983.513
7°30′	49.998	99.981	149.936	199.848	249.703	299.486	349.184	398.783	448.267	497.624	546.839	595.898	644.787	693.491	741.999	790.295	838.365	886.197	933.777	981.091
8°00′	49.997	99.978	149.927	199.827	249.662	299.416	349.072	398.615	448.029	497.298	546.404	595.334	644.071	692.598	740.901	788.964	836.771	884.307	931.557	978.506
8°30′	49.997	99.976	149.917	199.804	249.618	299.340	348.953	398.437	447.776	496.950	545.942	594.735	643.309	691.648	739.734	787.549	835.077	882.299	929.199	975.759
9°00′	49.997	99.973	149.907	199.781	249.572	299.260	348.826	398.248	447.507	496.581	545.452	594.099	642.502	690.642	738.498	786.051	833.282	880.172	926.702	972.852
9°30′	49.996	99.969	149.897	199.756	249.523	299.176	348.692	398.048	447.223	496.192	544.935	593.428	641.650	689.579	737.192	784.469	831.388	877.928	924.068	969.786
10°00′	49.996	99.966	149.886	199.729	249.472	299.087	348.551	397.838	446.923	495.782	544.389	592.721	640.752	688.459	735.818	782.804	829.395	875.567	921.297	966.562

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	33.333	66.667	100.000	133.334	166.668	200.002	233.336	266.671	300.006	333.342	366.678	400.014	433.352	466.689	500.028	533.367	566.707	600.048	633.390	666.733
1°00′	33.333	66.667	100.001	133.335	166.671	200.007	233.345	266.684	300.024	333.367	366.711	400.057	433.406	466.758	500.112	533.470	566.830	600.194	633.561	666.933
1°30′	33.333	66.667	100.002	133.338	166.676	200.016	233.359	266.705	300.055	333.408	366.766	400.129	433.498	466.872	500.253	533.640	567.034	600.437	633.847	667.266
2°00′	33.333	66.668	100.004	133.342	166.683	200.029	233.379	266.735	300.097	333.468	366.844	400.230	433.626	467.032	500.450	533.879	567.321	600.777	634.248	667.734
2°30′	33.334	66.668	100.006	133.347	166.693	200.045	233.405	266.773	300.152	333.541	366.944	400.360	433.791	467.238	500.703	534.187	567.691	601.216	634.764	668.336
3°00′	33.334	66.669	100.008	133.352	166.704	200.065	233.436	266.820	300.218	333.633	367.066	400.518	433.992	467.490	501.013	534.564	568.143	601.754	635.398	669.076
3°30′	33.334	66.670	100.011	133.359	166.718	200.088	233.473	266.875	300.297	333.741	367.210	400.706	434.231	467.789	501.381	535.011	568.680	602.392	636.149	669.954
4°00′	33.334	66.671	100.014	133.367	166.733	200.115	233.516	266.939	300.389	333.867	367.377	400.923	434.508	468.134	501.807	535.528	569.302	603.131	637.020	670.972
4°30′	33.334	66.672	100.018	133.376	166.751	200.146	233.565	267.012	300.492	334.009	367.567	401.169	434.821	468.527	502.291	536.117	570.009	603.973	628.013	672.133
5°00′	33.334	66.673	100.022	133.387	166.771	200.180	233.619	267.093	300.608	334.168	367.779	401.445	435.173	468.968	502.834	536.778	570.804	604.919	639.129	673.439
5°30′	33.334	66.675	100.027	133.398	166.793	200.218	233.679	267.183	300.736	334.344	368.014	401.752	435.563	469.456	503.436	537.511	571.687	605.971	640.371	674.893
6°00′	33.335	66.676	100.032	133.410	166.817	200.259	233.745	267.282	300.877	334.538	368.272	402.088	345.992	469.993	504.099	538.319	572.660	607.131	641.741	676.499
6°30′	33.335	66.678	100.038	133.423	166.843	200.304	233.817	267.389	301.030	334.749	368.554	402.454	436.460	470.580	504.824	539.202	573.724	608.401	643.242	678.260
7°00′	33.335	66.680	100.044	133.438	166.871	200.353	233.894	267.505	301.196	334.977	368.858	402.851	436.967	471.216	505.610	540.161	574.882	609.783	644.878	680.181
7°30′	33.335	66.682	100.051	133.453	166.901	200.405	233.978	267.630	301.375	335.223	369.187	403.280	437.514	471.903	506.460	541.199	576.134	611.280	646.652	682.267
8°00′	33.335	66.684	100.058	133.470	166.933	200.461	234.067	267.764	301.566	335.486	369.539	403.739	438.101	472.641	507.374	542.316	577.484	612.896	648.569	684.522
8°30′	33.336	66.686	100.065	133.487	166.968	200.521	234.162	267.907	301.770	335.767	369.915	404.231	438.730	473.432	508.354	543.515	578.934	614.633	650.631	686.952
9°00′	33.336	66.688	100.073	133.506	167.004	200.585	234.264	268.058	301.987	336.066	370.316	404.754	439.401	474.276	509.400	544.796	580.486	616.494	652.844	689.563
9°30′	33.336	66.691	100.081	133.526	167.043	200.652	234.371	268.219	302.217	336.384	370.741	405.310	440.113	475.174	510.515	546.163	582.143	618.484	655.214	692.363
10°00′	33.337	66.693	100.090	133.547	167.084	200.723	234.484	268.389	302.460	336.719	371.191	405.899	440.869	476.127	511.700	547.617	583.909	620.607	657.745	695.359

D. C.	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
0°30′	16.667	33.333	50.000	66.667	83.334	100.002	116.669	133.337	150.006	166.674	183.343	200.013	216.683	233.354	250.025	266.698	283.370	300.044	316.718	333.394
1°00′	16.667	33.334	50.001	66.669	83.337	100.007	116.677	133.349	150.022	166.697	183.374	200.052	216.733	233.416	250.102	266.790	283.482	300.176	316.874	333.575
1°30′	16.667	33.334	50.002	66.671	83.342	100.015	116.690	133.368	150.050	166.735	183.424	200.118	216.816	233.520	250.230	266.945	283.668	300.397	317.134	333.878
2°00′	16.667	33.334	50.003	66.674	83.348	100.026	116.708	133.395	150.088	166.788	183.494	200.209	216.933	233.665	250.409	267.163	283.928	300.707	317.498	334.303
2°30′	16.667	33.335	50.005	66.679	83.357	100.041	116.731	133.430	150.138	166.856	183.585	200.327	217.082	233.853	250.639	267.443	284.264	301.106	317.968	334.852
3°00′	16.667	33.336	50.007	66.684	83.367	100.059	116.760	133.473	150.199	166.939	183.696	200.471	217.266	234.082	250.922	267.786	284.676	301.595	318.544	335.525
3°30′	16.667	33.336	50.010	66.690	83.380	100.080	116.794	133.523	150.270	167.038	183.827	200.642	217.483	234.354	251.256	268.192	285.165	302.176	319.228	336.324
4°00′	16.667	33.337	50.013	66.698	83.394	100.105	116.833	133.581	150.353	167.152	183.979	200.839	217.735	234.668	251.643	268.663	285.731	302.849	320.021	337.251
4°30′	16.667	33.338	50.017	66.706	83.410	100.132	116.877	133.647	150.448	167.281	184.152	201.063	218.020	235.026	252.084	269.199	286.375	303.615	320.925	338.308
5°00′	16.667	33.339	50.020	66.715	83.428	100.163	116.926	133.721	150.553	167.426	184.345	201.315	218.340	235.426	252.578	269.800	287.098	304.477	321.942	339.498
5°30′	16.668	33.341	50.025	66.725	83.443	100.198	116.981	133.803	150.670	167.586	184.559	201.593	218.695	235.871	253.127	270.469	287.903	305.436	323.074	340.824
6°00′	16.668	33.342	50.029	66.736	83.470	100.236	117.041	133.893	150.798	167.762	184.794	201.899	219.086	236.360	253.731	271.205	288.790	306.493	324.324	342.290
6°30′	16.668	33.344	50.034	66.748	83.493	100.277	117.106	133.991	150.937	167.954	185.050	202.233	219.512	236.895	254.391	272.010	289.760	307.652	325.694	343.898
7°00′	16.668	33.345	50.040	66.762	83.519	100.321	117.177	134.096	151.088	168.162	185.327	202.595	219.974	237.475	255.108	272.885	290.816	308.913	327.188	345.653
7°30′	16.668	33.347	50.046	66.776	83.546	100.369	117.253	134.210	151.250	168.385	185.626	202.985	220.472	238.101	255.883	273.832	291.960	310.281	328.809	347.560
8°00′	16.669	33.349	50.052	66.791	83.576	100.420	117.334	134.332	151.424	168.625	185.947	203.404	221.008	238.774	256.717	274.852	293.193	311.757	330.562	349.624
8°30′	16.669	33.351	50.059	66.807	83.607	100.474	117.421	134.461	151.610	168.881	186.290	203.851	221.581	239.496	257.612	275.946	294.518	313.346	332.450	351.849
9°00′	16.669	33.353	50.066	66.824	83.641	100.532	117.513	134.599	151.808	169.154	186.655	204.329	222.193	240.266	258.568	277.118	295.938	315.050	334.477	354.244
9°30′	16.669	33.355	50.074	66.842	83.676	100.593	117.610	134.746	152.017	169.443	187.043	204.836	222.843	241.086	259.586	278.368	297.455	316.873	336.650	356.814
10°00′	16.670	33.358	50.082	66.861	83.713	100.657	117.713	134.900	152.239	169.749	187.453	205.374	223.534	241.957	260.670	279.699	299.072	318.819	338.973	359.566

Part 3

SPIRAL PROBLEMS

TYPICAL SOLUTION OF SPIRAL ELEMENTS AND DEFLECTION ANGLES

(Curve with spirals of equal length)

EXAMPLE I

Given:

$D = 6°$

$\Delta = 45°$

$L = 400'$

Station of P. S. = 321 + 11.5

To find elements of spiral and main curve and to determine deflection angles from P. S. to points on the spiral.

$$a = \frac{100\,D}{L} = \frac{600}{400} = 1.5$$

$$S = \frac{D\,L}{200} = \frac{6 \times 400}{200} = 12°$$

$i = \frac{1}{3}\,S - n = 3°59'55''$ (Table IV) or
$4°$ for practical purposes

From Table IV

$C = .998052 \times 400 = 399.22'$
$Y = .995622 \times 400 = 398.25'$
$X = .069595 \times 400 = 27.84'$
$U = .668205 \times 400 = 267.28'$
$V = .334732 \times 400 = 133.89'$
$p = .017426 \times 400 = 6.97'$
$q = .499270 \times 400 = 199.71'$

DEFLECTION ANGLES TO POINTS ON SPIRAL

P. S. to Station	Distance Feet	Defl. Min. (Table II)		a		Deflection Angle
321 + 50	38.5	1.48 Min.	×	1.5	=	0°02.2′
322	88.5	7.83 Min.	×	1.5	=	0°11.7′
+ 50	138.5	19.18 Min.	×	1.5	=	0°28.8′
323	188.5	35.53 Min.	×	1.5	=	0°53.3′
+ 50	238.5	56.88 Min.	×	1.5	=	1°25.3′
324	288.5	83.23 Min.	×	1.5	=	2°04.8′
+ 50	338.5	114.57 Min.	×	1.5	=	2°51.9′
325	388.5	150.91 Min.	×	1.5	=	3°46.4′
+ 11.5 (P.S.C.)	400.0	159.97 Min.	×	1.5	=	4°00.0′

Set up on P. S. C. and turn tangent by turning 8° from P. S.

Then from Table I—deflection angles for 6° curve.

P. S. C. to Station	Distance Feet		Defl. per Ft. Min.		Deflection Angle
325 + 50	38.5	×	1.8	=	1°09.3′
326	88.5	×	1.8	=	2°39.3′

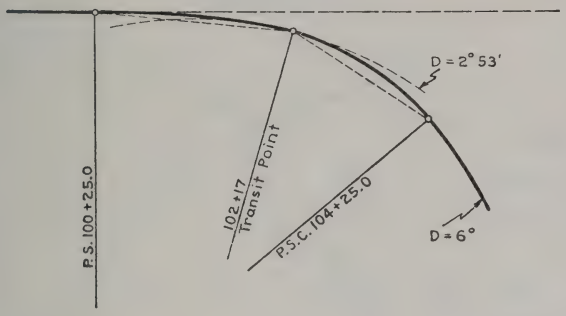
SOLUTION OF SEMI-TANGENT Ts

$$Ts = q + (R + p) \operatorname{Tan} \frac{\Delta}{2}$$

$$= 199.71 + (954.93 + 6.97) \ .4142136$$
$$= 598.14$$

INTERMEDIATE SETUP ON SPIRAL WITH DEFLECTIONS

EXAMPLE II



Given:

S = 12°00′
D = 6°00′
a = 1.5
L = 400′
P. S. = 100 + 25.0
P. S. C. = 104 + 25.0

Assume it is necessary to make intermediate setup at Sation 102 + 17.

Rule: A spiral deviates from the simple curve common to it at any point at the same rate as it deviates from the tangent at the P. S. Therefore, at any point on the spiral the deflection angle from the tangent at that point to any other point on the spiral is equal to the deflection angle for a simple curve of the same degree as the spiral at the intermediate setup plus or minus the deflection from tangent at the P. S. to a point at an equivalent distance from the P. S. thus:

Station	Simple Curve Deflection (D = 2°53′)*		Spiral Deflection Table II		Deflection (Instr. at Sta. 102 + 17)*
PS 100 + 25.0	2°45.9′	—	0°55.3′	=	1°50.6′
+ 50	2°24.3′	—	0°41.8′	=	1°42.5′
101	1°41.1′	—	0°20.5′	=	1°20.6′
+ 50	0°57.9′	—	0°06.7′	=	0°51.2′
102	0°14.7′	—	0°00.4′	=	0°14.3′
Transit Point + 17	0°00.0′		0°00.0′		0°00.0′
+ 50	0°28.5′	+	0°01.6′	=	0°30.1′
103	1°11.7′	+	0°10.3′	=	1°22.0′
+ 50	1°54.9′	+	0°26.5′	=	2°21.4′
104	2°38.1′	+	0°50.2′	=	3°28.3′
PSC + 25	2°59.7′	+	1°04.9′	=	4°04.6′

* Degree of curve at point of intermediate setup $= \frac{a\ l}{100}$

Sta. 102 + 17 $= \frac{1.5 \times 192}{100} = 2°52.8′$

DEFLECTIONS TO SPIRAL FROM P. S. C. OR P. C. S.

EXAMPLE III

Given:

L = 400′

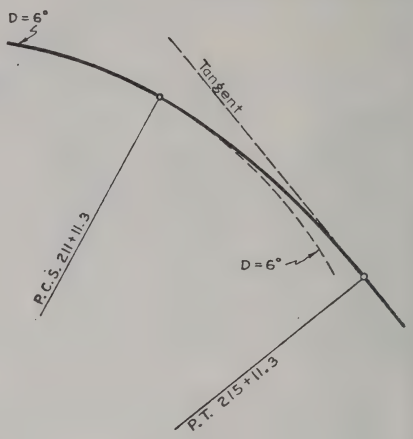
S = 12°00′

D = 6°00′

a = 1.5

P. C. S. 211 + 11.3

P. T. 215 + 11.3



To back the spiral in from P. C. S.

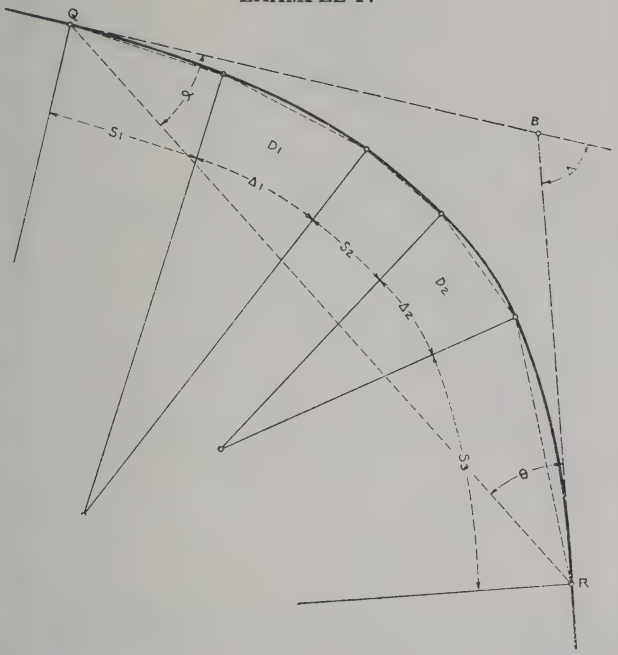
Rule: A spiral curve and a simple curve which coincide at any point (as at the P. C. S.) deviate from each other at the same rate as the spiral does from the tangent at the P. S.

Therefore, to obtain deflection angles from the tangent to the curve at the P. C. S. to the spiral, compute deflection angles to the simple curve and subtract therefrom the deflection angles to the spiral at corresponding distances from the P. S.

Station	Simple Curve Deflection (D = 6°)	Spiral Deflection Table II	Deflections (Instr. at P. C. S.)
P. C. S. 211 + 11.3	0°00.0′	— 0°00.0′	= 0°00.0′
+ 50	1°09.7′	— 0°02.2′	= 1°07.5′
+ 75	1°54.7′	— 0°06.1′	= 1°48.6′
212	2°39.7′	— 0°11.8′	= 2°27.9′
+ 35	3°42.7′	— 0°23.0′	= 3°19.7′
+ 80	5°03.7′	— 0°42.7′	= 4°21.0′
213 + 20	6°15.7′	— 1°05.3′	= 5°10.4′
+ 50	7°09.7′	— 1°25.5′	= 5°44.2′
214	8°39.7′	— 2°05.0′	= 6°34.7′
+ 50	10°09.7′	— 2°52.1′	= 7°17.6′
215	11°39.7′	— 3°46.6′	= 7°53.1′
+ 11.3	12°00.0′	— 4°00.0′	= 8°00.0′

METHOD OF FITTING A SPIRAL BETWEEN TWO PARTS OF A COMPOUND CURVE WITH SPIRAL TRANSITIONS AT EACH END

EXAMPLE IV



Given:

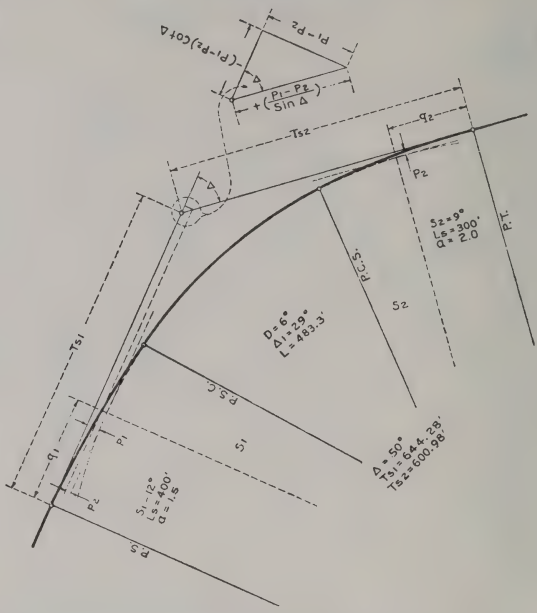
Δ
D_1
D_2
Ls_1, Ls_2 and Ls_3 (Spiral lengths)

To find Semi-tangents:

(1) Ascertain Δ_1 (by assumption or measurement).
(2) Then $\Delta_2 = \Delta - \Delta_1$, $-S_1$, $- S_2$, $- S_3$.
(3) Find long chords for simple curves and spirals.
(4) Figure bearings for chords.
(5) Compute coordinates for point "R".
(6) Compute length and bearing of long chord Q-R.
(7) Then $\theta = \Delta - \alpha$:
(8) Solve triangle QBR for semi-tangents QB and BR. (Three angles and one side known.)
(9) Spiral S_2 may be used to connect curves D_1 and D_2 by choosing that portion of the spiral having curvature intermediate between the degree of the two simple curves; thus if $D_1 = 3°$ and $D_2 = 10°$ the connecting spiral will vary from 3° to 10° omitting the portion of the spiral below 3°. Deflection angles from P. C. S. or P. S. C. may be computed in the same manner as for an intermediate setup on the spiral (see Example II).

METHOD OF COMPUTING SEMI-TANGENTS FOR CURVES WITH SPIRALS OF UNEQUAL LENGTH

EXAMPLE V



Given:

$Ls_1 = 400'$
$Ls_2 = 300'$
$D = 6°00'$
$\Delta = 50°00'$

To compute Semi-tangents ascertain the spiral elements from the tables as in Example I. Then

$$Ts_1 = q_1 + (R + p_2) \text{ Tan } \frac{\Delta}{2} - (p_1 - p_2) \text{ Cot } \Delta$$

$$Ts_2 = q_2 + (R + p_2) \text{ Tan } \frac{\Delta}{2} + \frac{p_1 - p_2}{\text{Sin } \Delta}$$

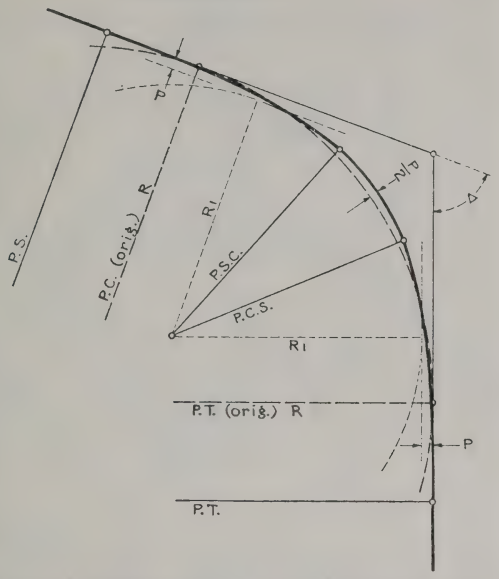
$Ts_1 = 199.71 + (954.93 + 3.92) \times .4663077 -$
$(6.97 - 3.92) .8390996 = 644.27$

$Ts_2 = 149.88 + (954.93 + 3.92) \times .4663077 +$
$\frac{6.97 - 3.92}{.7660444} = 600.98$

Rule: Ls_1 = Longer Spiral

METHOD OF FITTING EXISTING SIMPLE CURVE ALIGNMENT WITH SPIRALED CURVES REQUIRING A MINIMUM SHIFT OF ALIGNMENT

EXAMPLE VI



Given:
D
R
Δ
Ls

Find: D_1

To retain present tangents and fit spiraled alignment with least possible shift of simple curve.

The new curve will be sharper and it should lay outside of the old curve at the vertex, and the distance between the vertexes of the two curves should be equal to half the spiral offsets, $\frac{p}{2}$.

$$\text{Then } R_1 = R - \frac{p + \frac{p}{2}\cos\frac{\Delta}{2}}{1 - \cos\frac{\Delta}{2}}$$

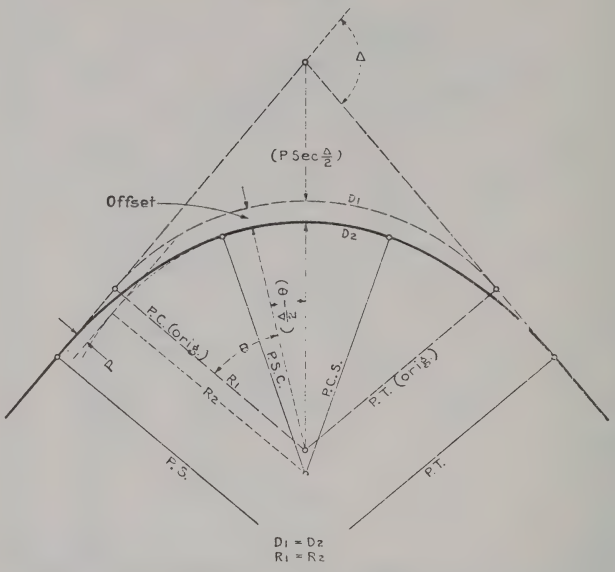
In solving this equation, a value of "p" must be assumed. This value will be slightly greater than the value of "p" for a degree of curve equal to the original curve. The assumption should be based on an estimate of the new degree of curve required.

Then revise the value of "p" to fit alignment.

$$D_1 = \frac{5729.578}{R_1}$$

OFFSETS FROM SIMPLE CURVE ALIGNMENT TO SPIRALED ALIGNMENT USING SAME DEGREE OF CURVE AND ORIGINAL TANGENTS

EXAMPLE VII

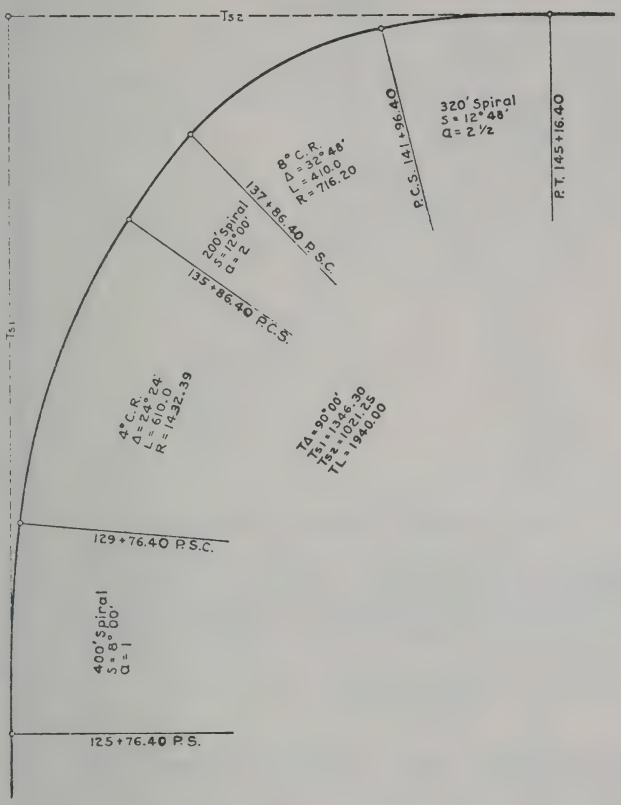


In fitting spiraled alignment to existing simple curve alignment, retaining the same degree of main curve and the original tangents, it will be found that the new main curve is neither concentric with nor parallel to the original curve. The offset varies from a value of "p" as shown on the sketch to a value of (p Sec $\frac{\Delta}{2}$) at the vertex. Between the point where the value of "p" applies to the P. S. C. the offsets from the original alignment to the new alignment may be found by obtaining the X coordinate to the point in question on the spiral and making correction for the offset to the original simple curve where that is necessary. Beyond the P. S. C. the following approximate formula will give values of the offset sufficiently close for practical purposes.

$$\text{Offset} = \text{p Sec}\frac{\Delta}{2}\left[\cos\left(\frac{\Delta}{2} - \theta\right)\right] \text{ Approximately}$$

Where θ = angle from the P. C. or P. T. of original simple curve to the point desired.

EXAMPLE VIII

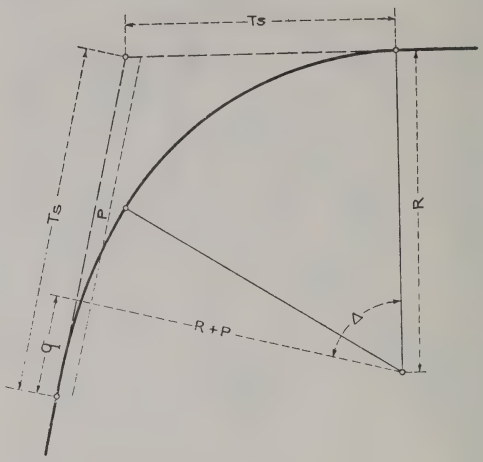


STANDARD METHOD OF SHOWING ALIGNMENT ON MAPS

Stationing to be shown to the nearest hundredth of a foot. Angles and Bearings shown to the nearest half Minute.

METHOD OF COMPUTING SEMI-TANGENTS OF CURVE WITH SPIRAL AT ONE END ONLY

EXAMPLE IX



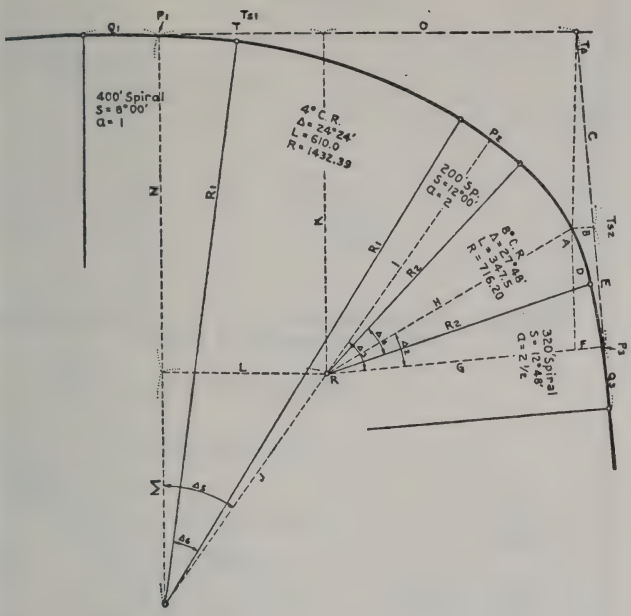
When Δ is less than 90°

$$Ts = \frac{(R + p) - (R \cos \Delta)}{\text{Sine } \Delta}$$

$$Ts_1 = \frac{R - (R + p) \text{ Cos } \Delta}{\text{Sine } \Delta} + q$$

When Δ is over 90°, the cos function has a negative value.

EXAMPLE X



COMPOUND CURVE WITH THREE SPIRALS

With a given or assumed semi-tangent or a fixed pass through point. Total angle and radii of both curves known.

In case of fixed pass through point, to find Ts_2: Assume Ts_1 as the basis of co-ordinates with the P. I. as the origin of co-ordinates calculate from known ties the co-ordinates of pass through point. From co-ordinates calculate C and B. Then

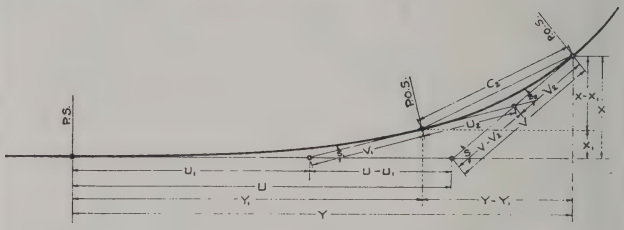
$B = F$, $G = (R_2 + p_3) - F$, $H = R_2$, cosine $\Delta^2 = \frac{G}{H}$, $D = H$ sine Δ^2, $E = D$ and $Ts_2 = C + E + Q_3$.

Having fixed or assumed Ts_2, to find Ts_1, and Δ of curves: Calculate co-ordinates of radius point "R". Then $K =$ departure of R and $O =$ latitude of R. p_2 is the p distance for a spiral for a curve whose degree is $D_2 - D_1$. Then $I = R_2 + p_2$.

$J = R_1 - I$, $K = N$, $M = (R_1 + p_1) - N$, cosine $\Delta^5 = \frac{M}{J}$, $L = J$ sine Δ^5, $T = L$, $\Delta^6 = \Delta^5 - (S_1 + \Delta$ for D_1 for ½ length of intermediate Spiral), $\Delta^3 = T\Delta - \Delta^5$, $\Delta^4 = \Delta^3 - (S_3 + \Delta$ for D_2 for ½ length of intermediate spiral) $Ts_1 = O + T + Q_1$; the use of ½ the length of the intermediate spiral is a close approximation of the true answer.

METHOD OF DETERMINING U, V, AND C DISTANCES FOR SEGMENT OF A SPIRAL

EXAMPLE XI

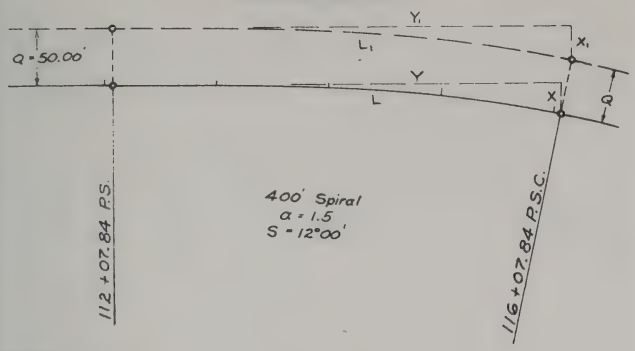


$$S_2 = S - S_1 \qquad V_2 = V - \frac{(U-U_1)\sin S_1}{\sin S_2}$$

$$U_2 = \frac{(U-U_1)\sin S}{\sin S_2} - V_1 \qquad C_2 = \sqrt{(X-X_1)^2 + (Y-Y_1)^2}$$

METHOD OF COMPUTING OFFSET SPIRALS

EXAMPLE XII



Given:

$L = 400.00'$

$a = 1.5$

$S = 12°00'00''$

$Q = 50.00$ (Outside offset)

Formulae:

$$\theta = S \text{ (in radians) for the base spiral} = \frac{S°}{57.29578}$$

$Q =$ Offset in feet

$L_1 = L \pm Q\theta$

$X_1 = X \pm Q\ (1 - \cos S)$ Use + for outside offset

$Y_1 = Y \pm Q \sin S$ — for inside offset

To compute the spiral offset as it would be run in the field setting stakes at right angles to and "Q" offset from the corresponding stations on the base spiral with transit setup at the P. S. or P. T. of the offset spiral:

(1) Find the S angle for each station using Table II, interpolating if necessary.

(2) Determine length of the offset spiral, L_1, from P. S. or P. T. to each station.

(3) Using S angles found in step 1, determine the corresponding X and Y values for each station of the base spiral.

(4) Determine the X_1 and Y_1 values for the offset spiral.

(5) Determine the offset spiral deflections from $\tan i_1 = \frac{X_1}{Y_1}$.

(6) Calculate chords using formula in example XI.

Note: It is emphasized that the offset spiral is not related to the Standard Highway Spiral and the usual procedure is not valid.

TABULATION OF RESULTS FOR ABOVE DATA

Station	L	S°	L_1	X	Y	X_1	Y_1	i_1	C_1
112 + 07.84 P. S.	0	0°00′00″	0.00	0.00	0.00	0.00	0.00	0°00.0′	0.00
+ 50	42.16	0°08′00″	42.28	0.03	42.16	0.03	42.28	0°02.4′	42.28
113	92.16	0°38′13″	92.72	0.34	92.16	0.34	92.72	0°12.6′	50.44
+ 50	142.16	1°30′57″	143.48	1.25	142.15	1.27	143.47	0°30.6′	50.76
114	192.16	2°46′10″	194.58	3.10	192.12	3.16	194.54	0°55.8′	51.10
+ 50	242.16	4°23′53″	246.00	6.20	242.01	6.35	245.84	1°28.8′	51.39
115	292.16	6°24′07″	297.75	10.88	291.79	11.19	297.36	2°09.3′	51.75
+ 50	342.16	8°46′50″	349.82	17.45	341.35	18.04	348.98	2°57.5′	52.07
116	392.16	11°32′03″	402.23	26.25	390.57	27.26	400.57	3°53.6′	52.41
+ 07.84 P S.C.	400.00	12°00′00″	410.47	27.84	398.25	28.93	408.65	4°03.0′	8.24

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